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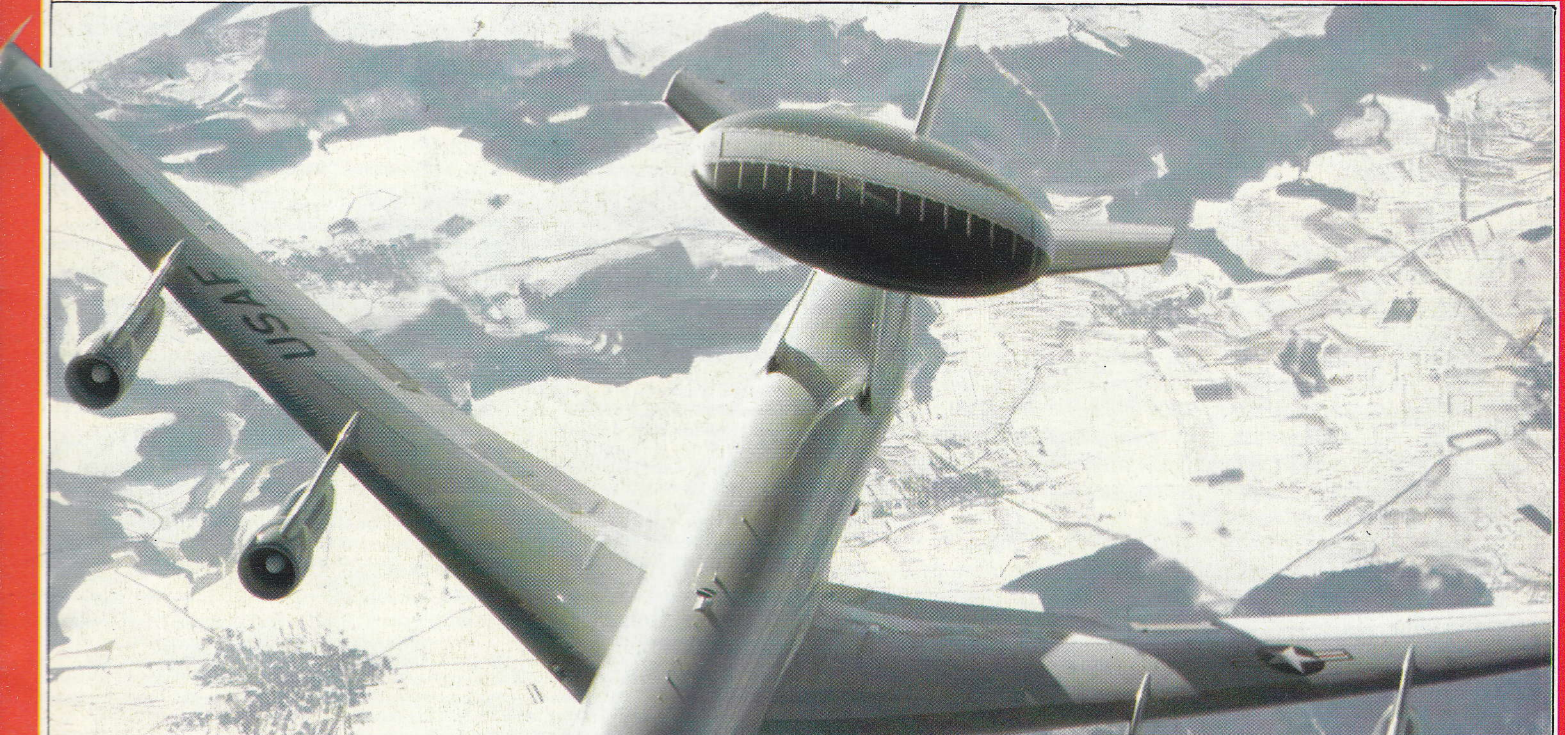

History of AEW

Hawkeye in Action

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AWACS in Action

Armed Forces of the World: US Air Force (Part 6)

A fully illustrated guide to Airborne Early Warning Aircraft

WAR MACHINE

Volume 5 **Issue 50**

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Airborne Early Warning Aircraft

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Armed Forces of the World

US Air Force (Part 6) iii

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Editorial Offices
War Machine
Aerospace Publishing Ltd
10 Barley Mow Passage
London W4 4PH

Managing Editor: Stan Morse

Editorial: Trisha Palmer
Chris Bishop
Jon Lake
Chris Chant

Design: Rod Teasdale

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Artists:
John Ridyard
Keith Fretwell

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Telephone: 01-379 6711

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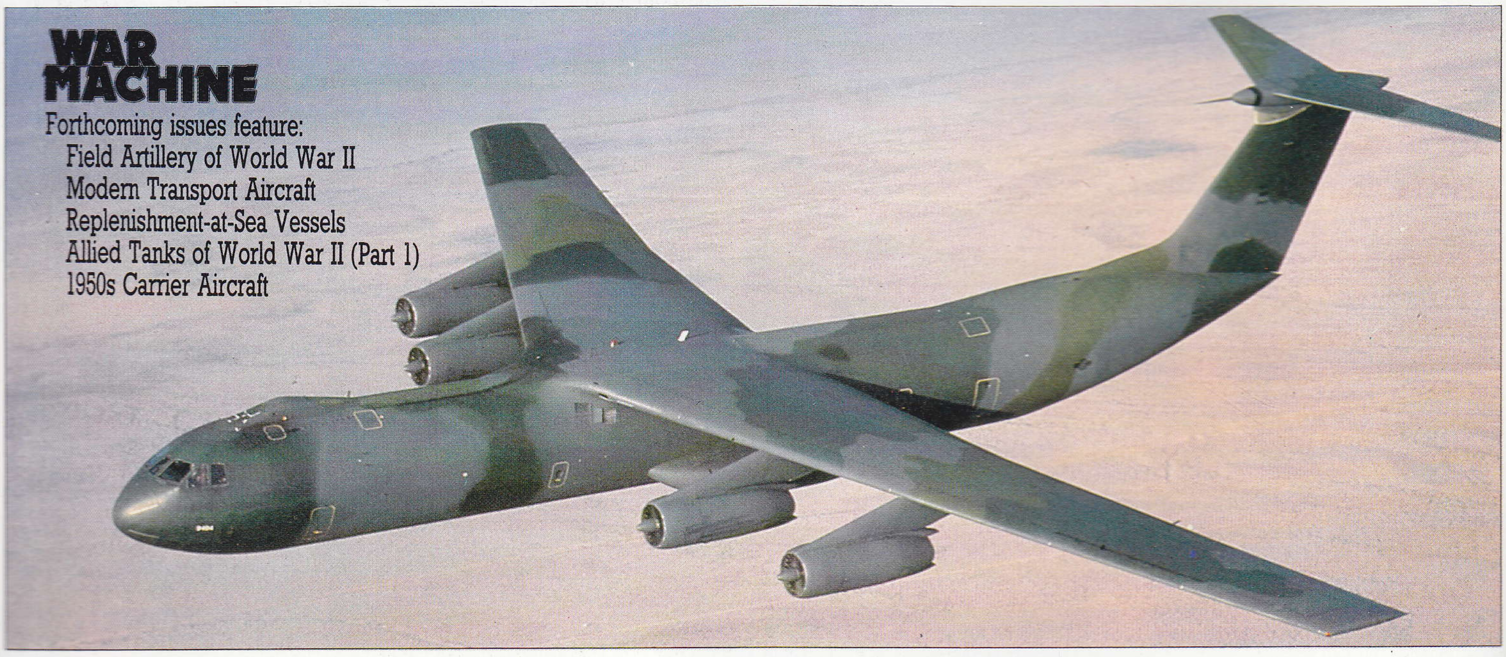


WAR MACHINE

Forthcoming issues feature:
- Field Artillery of World War II
- Modern Transport Aircraft
- Replenishment-at-Sea Vessels
- Allied Tanks of World War II (Part 1)
- 1950s Carrier Aircraft

Airborne Early Warning Aircraft

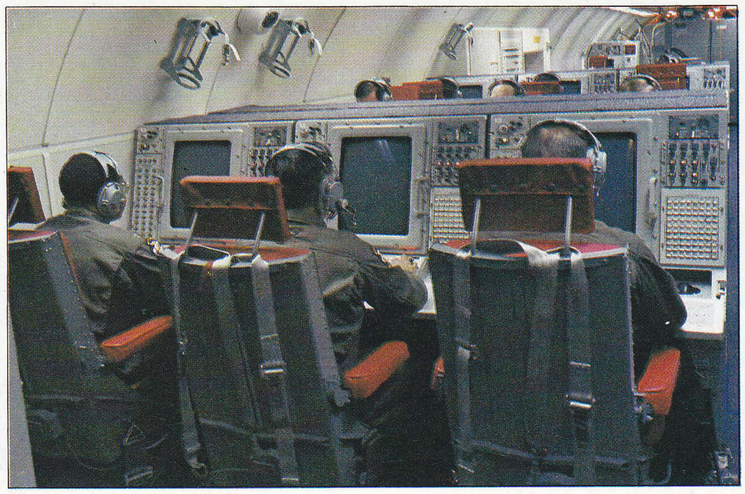
Pines

In the high-tech conflicts of 1982, the Royal Navy in the South Atlantic suffered from the lack of ship-based airborne early warning. In contrast, Israel used American-supplied Grumman Hawkeye aircraft to dominate the Lebanese skies to an unparalleled extent, proving the value of the concept as never before.

The very first military role of aviation was to look down on a battlefield and report on the enemy's movements. The first aircraft used for this purpose were balloons and man-lifting kites. Today large aircraft not only look down over vast areas of the Earth, but also have the ability to control a complete war situation in a way that was previously impossible.

The simplest part of the mission to understand is AEW (airborne early warning). In this a large surveillance radar is raised to a height of 8000 to 10000 m (26,250 to 32,800 ft) above the ground, from which vantage point its line-of-sight horizon is opened out from the 32 km (20 miles) or so at sea level to a distant 395 km (245 miles). This takes in an entire theatre of war, and enables a force commander to take in the whole situation in incredible detail. Thousands or even millions of items can be seen far beyond the sea-level horizon. Hostile aircraft or missiles can be spotted as soon as they are launched, and even hedge-hopping attackers can be seen throughout their flight. So, too, can wave-hugging anti-ship missiles.

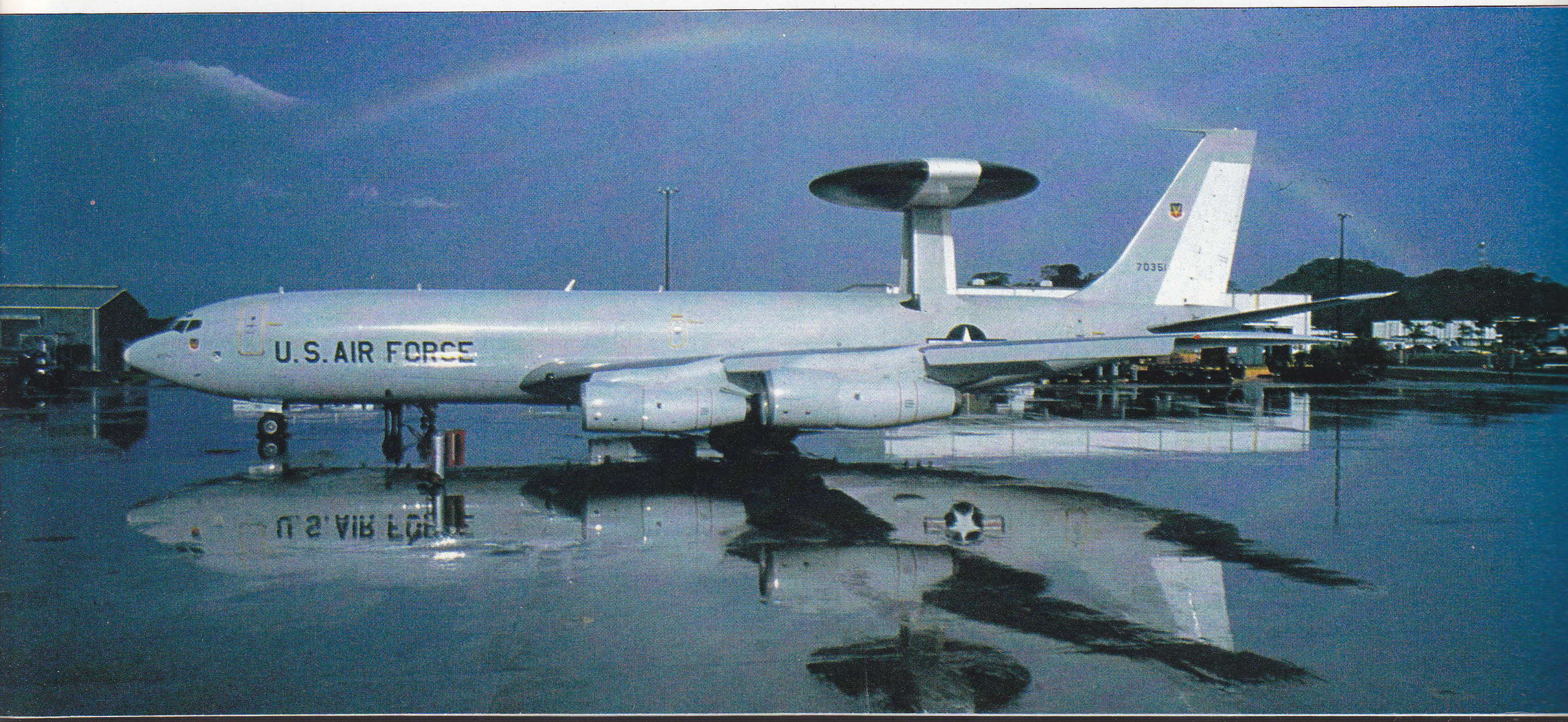
The sensors aboard the AEW platform always include this powerful radar. They can also include a passive detection system to pick up, locate and identify all radio, radar and other signals beyond the visual horizon, and without the platform itself making any telltale transmissions. Today such aircraft have been given enormously enhanced extra capability by the addition of very special communications and computers, which enable the airborne crew to exert a direct control function, and also to control or communicate with many kinds of friendly forces on the ground.



Inside a Boeing E-3A Sentry of the US Air Force almost the entire, very large space – which in 707s can provide seating for up to 189 passengers – is occupied by mission electronics and displays. Here operators are seated at the nine MPCs (multi-purpose consoles).

Externally, most of these amazing aircraft look strikingly different from anything else in the sky. At first they had the aerial (antenna) of the main surveillance radar mounted on the underside of the fuselage. Today it is usually either on top, on a tall pylon, or divided into two parts mounted on the nose and tail. But many members of the command post family have no radar other than that required for safe flight through bad weather, and these often look basically very like a passenger airliner. Their only visible differences lie in various kinds of communications aerials, which may be small blades for very (or ultra) high frequencies, arranged in rows along the top or bottom of the fuselage, or they may even be flush insulating (so-called dielectric) panels recessed into the skin. They may include long rods for HF (high-frequency) communications, projecting from the tip of the fin or wingtips. For special VLF (very low frequency) communications a long trailing wire may be used: the US Navy Boeing EC-130Q and Boeing E-6 use a wire 4 km (2.5 miles) long to 'talk' to submerged Trident submarines.

At Tinker AFB, Oklahoma, the USAF has the 966th AWAC Training Squadron and two operating units, the 963rd and 964th AWAC Squadrons. There are many overseas and support units, some flying EC-135 aircraft. The E-3 Sentry itself comes in four models: E-3A Core, E-3B, USAF Standard E-3A and the E-3C.



History of AEW

It has been obvious since man was in the trees that the higher the eye, the further it can see. Given the rapid development of radar in World War II it was inevitable that an attempt would be made to fly radar aerials far higher than the tallest ground-based radar mast.

The acronym AEW (airborne early warning) could be taken to extend back to the Battle of Fleurus in 1794, when French Colonel J-M.J. Coutelle used a balloon to obtain AEW of the enemy's movements. In practice it is taken to mean the use of radar and other sensors to obtain advance information of enemy air attacks, naval force movements and even land force dispositions, at distances many times greater than the limit possible with the human eye or other traditional warning methods.

Radar as a reliable and practical electronic warning system dates from 1936, but early sets weighed about a ton and required masts some 61 m (200 ft) in height. To fit a radar into an aeroplane took until 1937; on 16 August of that year a crude prototype of what was cryptically called RDF.2 took to the air in one of the RAF's first modern monoplanes, an Avro Anson Mk I (K6260). During World War II airborne radars were used solely for helping interceptors to engage hostile aircraft, bombers find their targets and maritime aircraft locate ships and U-boats, but in the final week of the war, on 8 August 1945, the American radio industry began work on Project Cadilla, the first big surveillance radar to provide complete coverage of a large area of the Earth's surface. The chief companies were General Electric and Hazeltine.

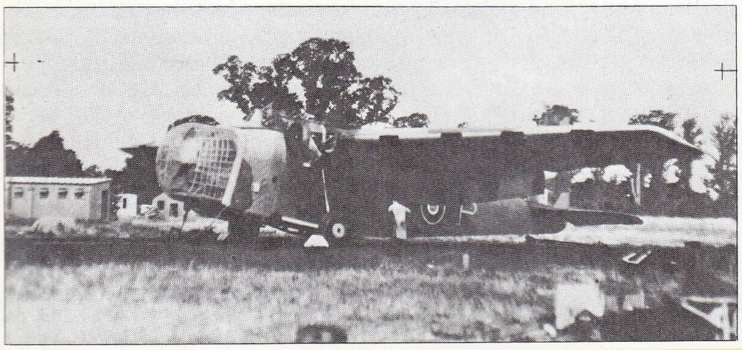
On 13 November 1946 the first flight prototype of the resulting radar, the APS-20, flew in a US Navy Grumman TBM-3W Avenger, the radar's presence being obvious from a colossal belly radome which, from its resemblance to the fat-bellied fish, resulted in the nickname of 'Guppy'. The next set to fly was a refined installation in a PB-1W, a US Navy designation for the Boeing B-17 Fortress. By 1948 production APS-20A radars were flying in such aircraft as the Lockheed P2V Neptune, Douglas AD-3W Skyraider and Grumman AF-2W Guardian. This classic radar had a peak output of 1 megawatt (one million watts), fed to a 2.44-m (8-ft) elliptical dish aerial rotating inside a giant fibreglass radome which posed severe structural problems. It operated in what was then called S-band (today E/F band). Shorter wavelengths were not possible, because of the time taken (even at the speed of light) for each pulse of energy to reach the target and return. For example at a target range of 160 km (100 miles) the timebase cannot run faster than 1,000 per second or the pulses will not return before the next one goes out. Thus the prf (pulse recurrence frequency) cannot be higher than 1,000. In the early stages there were also severe problems with the massive reflections from the ground or sea, which tended to obliterate the important targets such as ships or low-flying aircraft.

Gradually AEW radars were made to yield useful pictures, though they still demanded a high standard of operator skill, constant vigilance and completely manual operation and interpretation. APS-20A radars with minor variations were fitted to many aircraft in the 1950s including the Royal Navy's Fairey (later Westland) Gannet AEW.Mk 3. When these aircraft were withdrawn in about 1970 the same radars were transferred to RAF Avro Shackletons which had already seen long service as maritime patrol aircraft. These venerable Shackleton AEW.Mk 2s are still in service, though they will not have to go on much longer. Such noisy, uncomfortable and relatively cramped aircraft pose working conditions that seriously impair operator efficiency on long patrols, and their limited ceiling of some 6095 m (20,000 ft) inevitably restricts the maximum line-of-sight radius of vision to about 160 km (100 miles), 240 km (150 miles) less than with a high-flying jet.

With various models of USAF and US Navy Lockheed Super Constellation new AEW radars were used with much larger aerials, in some cases with the azimuth aerial rotating below the fuselage and an elevation aerial nodding in a giant fin-like fairing above the fuselage. The US Navy's Grumman E-1B Tracer, a variant of the S-2 Tracker ASW aircraft, pioneered the use of an AEW aerial rotating inside a giant saucer-like radome high above the fuselage. Its replacement, the Grumman E-2 Hawkeye, introduced a rotodome aerial which itself rotated on top of a dorsal pylon. The same idea was taken much further with the giant 9.14-m (30-ft) rotodome of the Westinghouse APY-1 radar designed for the Boeing E-3 Sentry of the USAF. Based on the airframe of the Model 707-320B, this aircraft raised operating heights to the 9145-m (30,000-ft) level, and with an unrefuelled endurance of 11 hours coupled with high radar power and comprehensive communications was worth its daunting cost. Like all modern AEW aircraft the E-3 has a pulse-Doppler radar able to provide both pulse reflections and also analyse Doppler (shift of frequency) data which vary according to the relative speed of the target. Successive E-3A, E-3B, NATO and E-3C versions have improved capability for use over both land and sea, as well as enhanced anti-jamming capability.

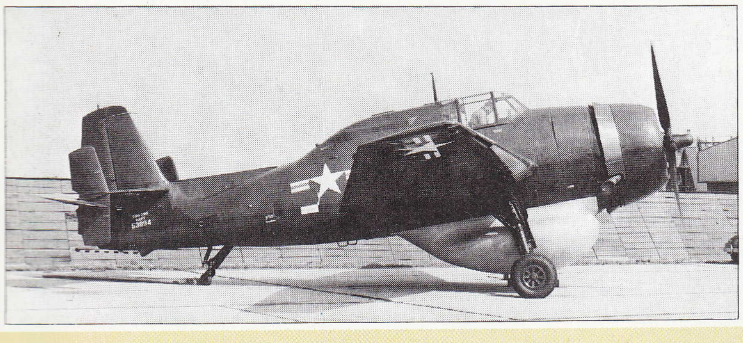
Little is known about the Soviet Tupolev Tu-126, which is a Tu-114 with a rotodome looking very like that of an E-3. US assessments have been derogatory, whereas the only evidence available showed the opposite, the performance of one of these monsters in the Indo-Pakistan war of 1971 proving decisive in enabling Indian attack aircraft to make deep and accurate interdiction missions by night. The Tu-126 is expected to be replaced by a modified Ilyushin Il-76 or Il-86.

Newest of the surveillance platforms are the British Nimrod AEW.Mk 3 and USAF Lockheed TR-1. The former is an outstandingly effective machine over land and sea, with a new arrangement of antennae at nose and tail each having an unobstructed view over 180°. The TR-1 is the newest member of the high-flying U-2 family, fitted with a synthetic-aperture radar which provides a picture of exceptional detail of all that goes on within a belt about 80 km (50 miles) wide to one side of the aircraft.



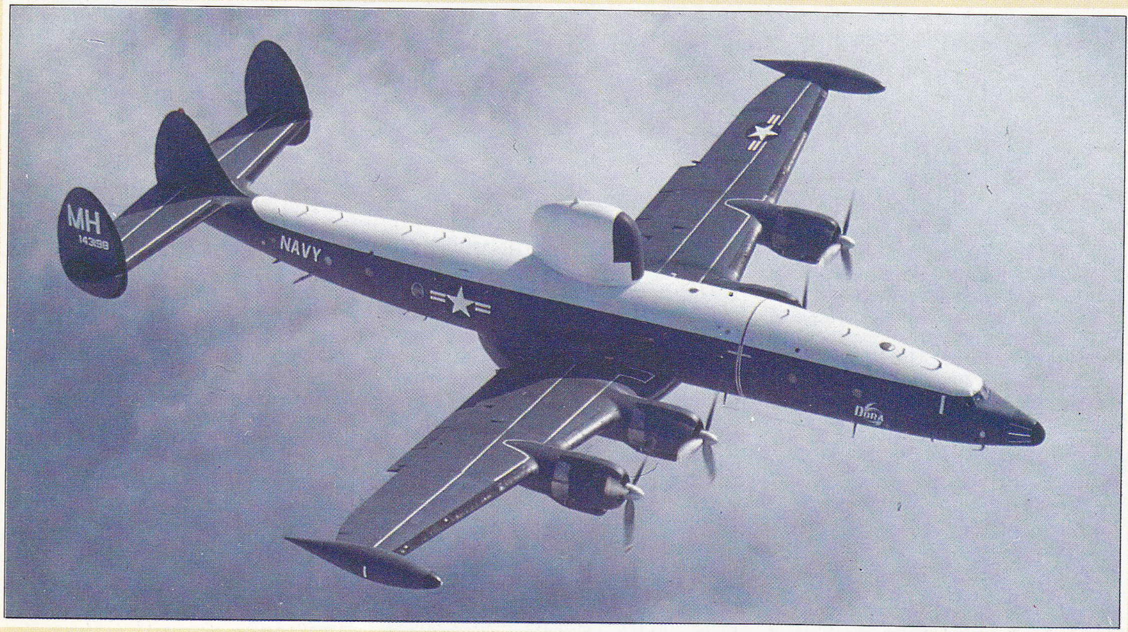
Because it had the biggest body cross-section in the RAF, a General Aircraft Hamilcar Mk X powered glider was used to test the first British AEW radar with 2.3-m (90-in) scanner. The lumbering machine was based at Telecommunications Flying Unit, Defford, until 10 February 1948.

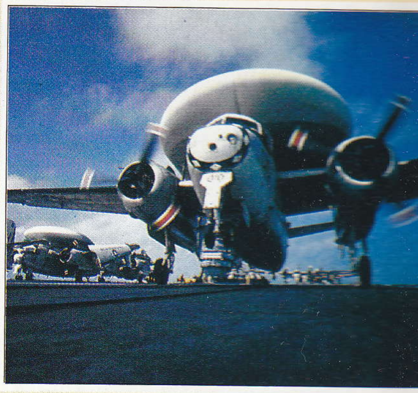
Britain's Fleet Air Arm was lucky enough to receive AD-4W Skyraider AEW aircraft under the MDAP aid programme, in 1951. They retained original Sea Blue Gloss finish, as they did not belong to Britain, and in this picture the November 1956 black/yellow 'Suez stripes' are seen.



A World War II design adapted to meet the US Navy's post-war anti-submarine needs was the Grumman Avenger, in this instance a TBM-3W-2 which carried the APS-20 radar in the large ventral housing, and had the rear turret replaced and faired over to house further detection equipment.

One can almost hear the familiar buzzing drone as a Westland (or, previously, Fairey) Gannet AEW.Mk 3 of Royal Navy No. 849B Flight comes in over the deck of HMS Ark Royal. *The black/yellow tail was painted after a visit to the USA. This mark of Gannet served from 1960-79.*

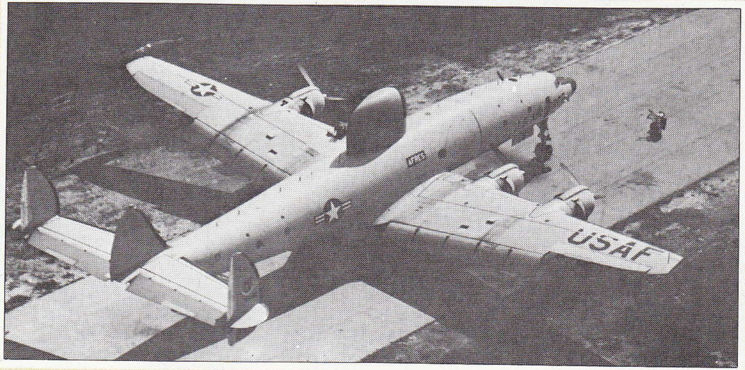




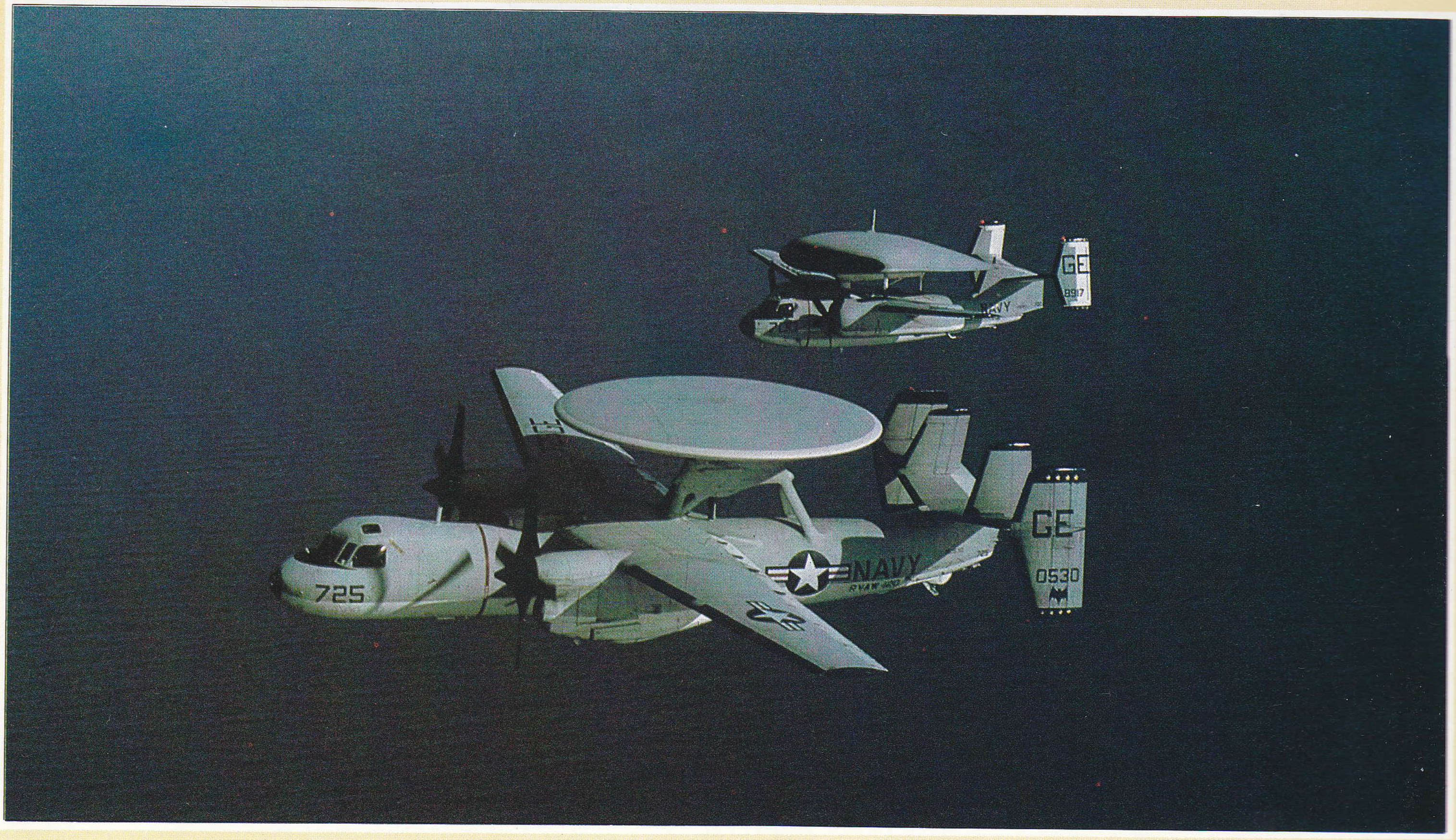
Above: The Grumman E-1 Tracer variant of the S-2 Tracker had a huge fixed radome above the fuselage, with a large APS-82 search radar rotating within the dome. A total of 88 E-1B Tracers was built.

Above: US Navy BuAer no. 143198 was a turbo-compound powered Lockheed WV-2 (later EC-121K) Warning Star. The narrow dorsal hump concealed a height-finding radar with a much larger belly radome covering an azimuthal radar.

Right: Lockheed EC-121 Warning Star versions of Super Constellation were the world's most important AEW aircraft from 1954 until the late 1960s, some continuing to serve in nine versions. This, one of the last with the USAF Reserve in the 1970s, was an EC-121Q or EC-121T.

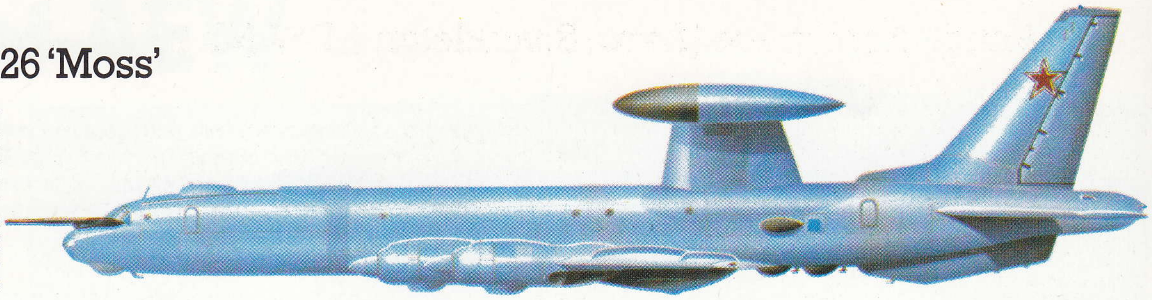


Below: The equipping of the large American attack carriers with the E-2A Hawkeye meant that the E-1B Tracer was gradually phased out of service, seeing out their days in the complement of the smaller 'Hancock' class ASW carriers. The later years of the Vietnam War saw both types in operation in the China Sea and the Gulf of Tonkin.



USSR

Tupolev Tu-126 'Moss'



Derived from the Tupolev Tu-114, the Tu-126 'Moss' is thought to augment Soviet ground-based air defence radars. The front of the rotodome contains a 'Flat Jack' surveillance radar, with the rear half thought to be devoted to IFF, data link and EW antennae.

A derivative of the Soviet Tu-114D airliner, the **Tupolev Tu-126 'Moss'** is optimized for airborne early warning and control tasks and was first identified during 1969. Apparently entering service in about 1971, it features the voguish dorsal rotodome, this being similar although, with an 11.0-m (36-ft) diameter, much larger than that of the American E-3 Sentry.

Containing 'Flat Jack' radar in the forward half, the rotodome in its rear houses an IFF array and may also contain data-link equipment, while passive and active electronic warfare antennae are located in four blister fairings on the rear fuselage sides and bottom. Installation of the rotodome has also necessitated a number of aerodynamic improvements, the most visible of which is the addition of a large ventral strake which offers improved longitudinal stability.

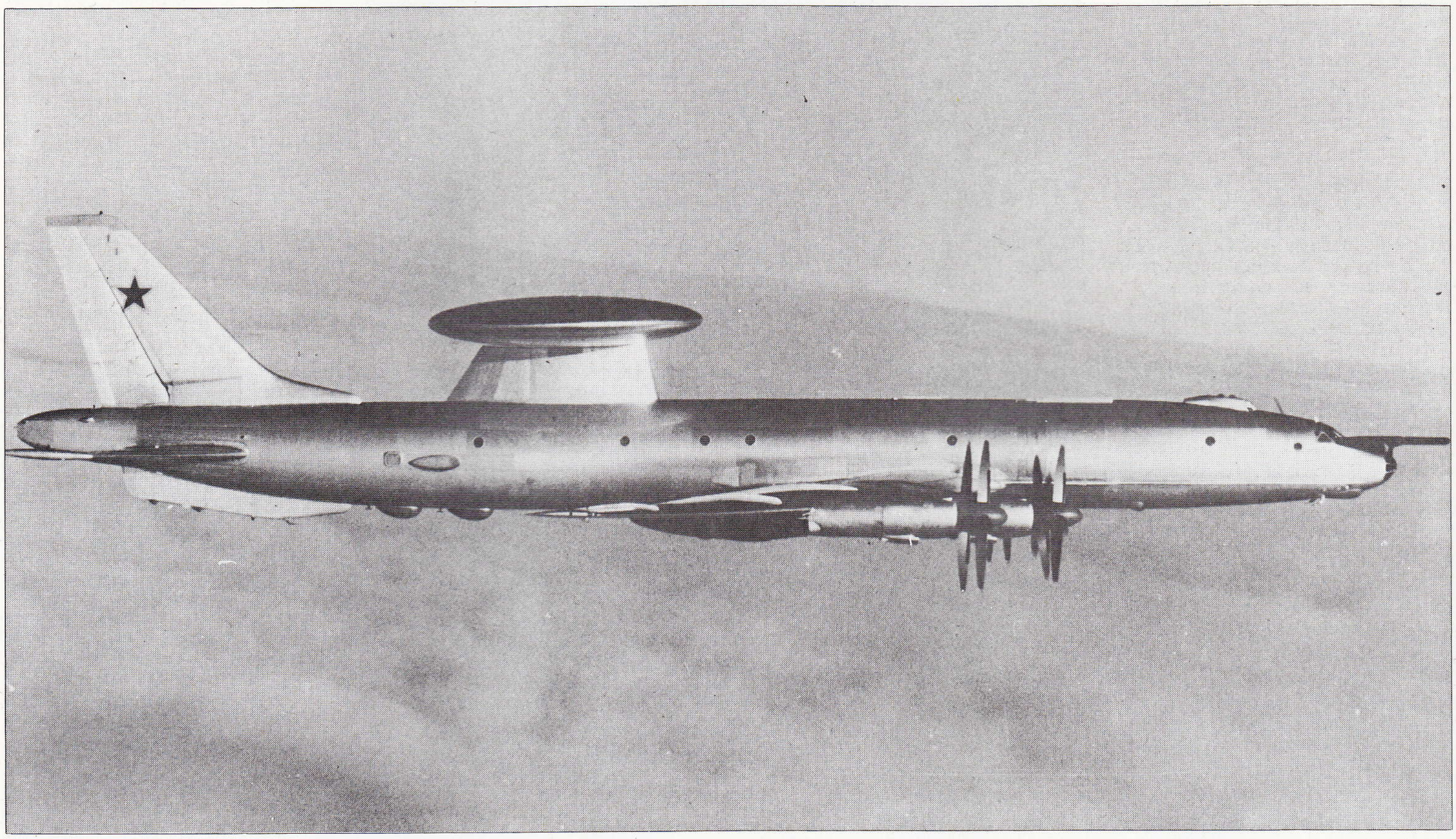
From an operational standpoint, the Tu-126's performance with regard to detection and tracking capability almost certainly leaves a great deal to be desired, a conclusion which would seem to be confirmed by recent estimates which indicate that only about a dozen aircraft are in service; that the Soviets are now working on an Ilyushin Il-76 AWACS aircraft also seems to bear witness to the Tu-126's less than satisfactory performance. Be that as it may, the 'Moss' is believed to possess powerful jamming equipment and may well have an offensive application in the stand-off jamming role.

With regard to operational use, the 'Moss' is thought to be mainly employed in augmenting Soviet ground-based radars, filling such gaps as exist in coverage and working in fairly close conjunction with interceptors to counter the threat posed by enemy strike aircraft operating at low level.

Specification

Tupolev Tu-126 'Moss'
Type: airborne warning and control system platform
Powerplant: four 14,795-eshp (11033-kW) Kuznetsov NK-12MV turboprops
Performance: maximum speed 740 km/h (460 mph) at altitude; service ceiling 10000 m (32,820 ft); endurance more than 20 hours.
Weights: empty 90720 kg (200,000 lb); maximum take-off 165550 kg (364,969 lb)
Dimensions: span 51.20 m (168 ft 0 in); length 57.30 m (188 ft 0 in) including inflight-refuelling probe; height 11.58 m (38 ft 0 in); wing area 311.2 m^2 (3,350 sq ft)

In the opinion of the Americans the Soviet Tupolev Tu-126 (called 'Moss' by NATO) has a generally poor radar performance and is 'ineffective' over land. The Indian Air Force, however, found it a most valuable aircraft during the 1971 war with Pakistan, and praised it highly.



USSR

Ilyushin 'Mainstay'

First flown in March 1971, the Ilyushin Il-76 'Candid' turbofan-powered tactical transport aircraft bears a distinct resemblance to the Lockheed C-141 StarLifter. From it has been developed the **Ilyushin 'Mainstay'**, intended to replace the Tupolev Tu-126 'Moss' AWACS platform. Recent reports from the USA indicate that this type is now in initial production, with deployment being expected in the fairly near future, but relatively little else is known although the type features the voguish pylon-mounted overfuselage rotodome, by all accounts situated adjacent to the wing leading edge.

Development of the 'Mainstay' was believed to have been initiated in the mid-1970s, and the radar is said to be highly sophisticated; some reports state that the aircraft also incorporates a dorsal fairing similar to that of the Boeing E-4B, and this may accommodate SHF communications antennae.

In standard tactical transport guise, the Ilyushin Il-76 'Candid' is powered by four Soloviev D-30KP turbofan engines, each rated at 12000-kg (26,455-lb) thrust, dimensions including a span of 50.50 m (165 ft 8 in) and a length of 46.60 m (152 ft 10½ in), whilst maximum take-off weight is of the order of 170100 kg (375,000 lb). In addition, some aircraft carry two 23-mm cannon in a radar-directed but manned rear turret.

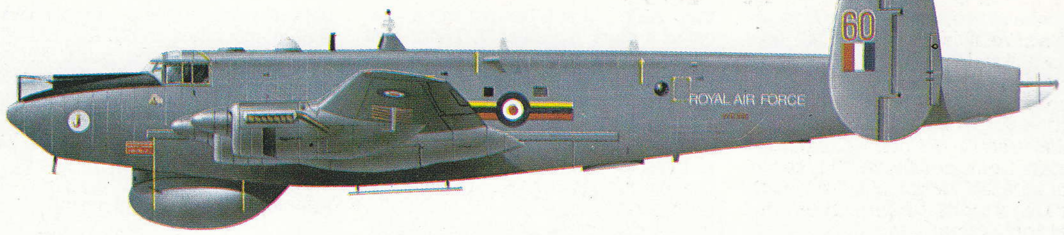
Present estimates suggest eventual deployment of about 50 examples of the 'Mainstay' AWACS model.

Specification

Details unknown.

UK

British Aerospace (Avro) Shackleton AEW.Mk 2



It is typical of the RAF that, perhaps through plain shortage of money, it was unable to provide itself with any AEW aircraft until the 1970s. Even then the radars were taken from defunct carrier-based Fairey Gannet AEW.Mk 3s, though with a major overhaul and update. The radar is, in fact, a direct descendant of the original APS-20 of 1946, and not all the skill and dedication of its operators could make up for its basically prehistoric design, absence of modern solid-state flexible memory, need for constant manual control and interpretation, and range limit of some 129 km (80 miles). To put such a set, and second-hand at that, into service with the RAF in 1972 is a sad reflection on the British planners and Treasury.

Even the aircraft were already well worn when, from 1970, they were channelled through RAF Kemble to be rebuilt by what was then Hawker Siddeley Aviation at Woodford and Bitteswell. Altogether 12 Shackleton MR.Mk 2 aircraft were rebuilt, the first flying at Woodford in **Shackleton AEW.Mk 2** form on 30 September 1971. Almost all the original maritime patrol and ASW (anti-submarine warfare) equipment was removed, and replaced by the APS-20F radar mounted mainly under the floor of the pilots' cockpit, with the 'guppy' radome in line with the contra-rotating propellers. All 12 aircraft were assigned to No. 8 Squadron at Kinloss, where they have been lovingly maintained and operated, mainly over sea areas around the UK and usually on practice missions in partnership with friendly combat aircraft. From 1973 improved AMTI (airborne moving-target indication) was added, with range increased slightly to about 185 km (115 miles). In 1981 budget cuts forced withdrawal of half the force, and by 1984 these six stalwart survivors were at last being replaced by the BAe Nimrod AEW.Mk 3, which represents new technology from stem to stern.

Specification

BAe (Avro) Shackleton AEW.Mk 2

Type: land-based AEW aircraft

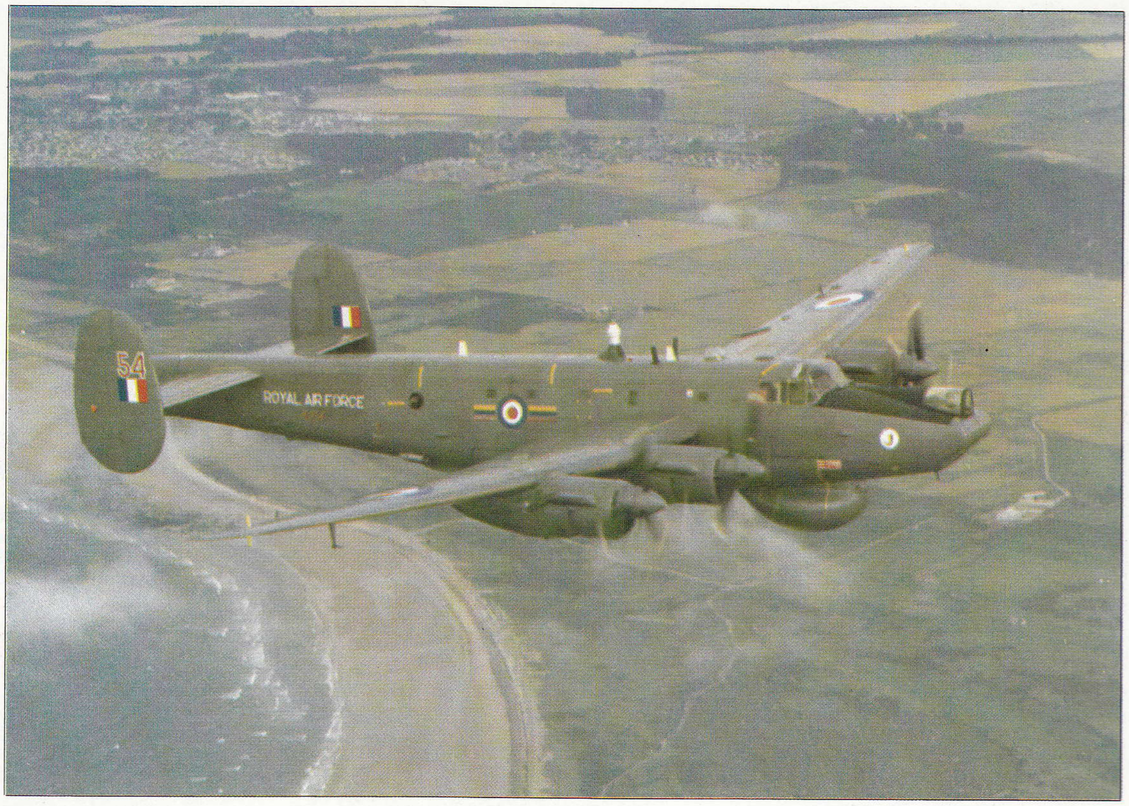
Powerplant: four 2,455-hp (1831-kW) Rolls-Royce Griffon 57A Vee-12 piston engines

Performance: maximum speed 439 km/h (272 mph); operating ceiling about 6095 m (20,000 ft); endurance normally 14 hours; range limit 6440 km (4,000 miles)

Weights: empty 25855 kg (57,000 lb); maximum take-off 44453 kg (98,000 lb)

Dimensions: span 36.58 m (120 ft 0 in); length 26.59 m (87 ft 3 in); height 5.1 m (16 ft 9 in); wing area 132.01 m^2 (1,421 sq ft)

The faithful old AEW Shackletons were given names from the Magic Roundabout TV series, this example being WR960 Dougal. They survived, thanks to the skill of their crews, but had a poor ceiling, and electronically they were archaic. Their operational life has been prolonged by delay to the Nimrod.

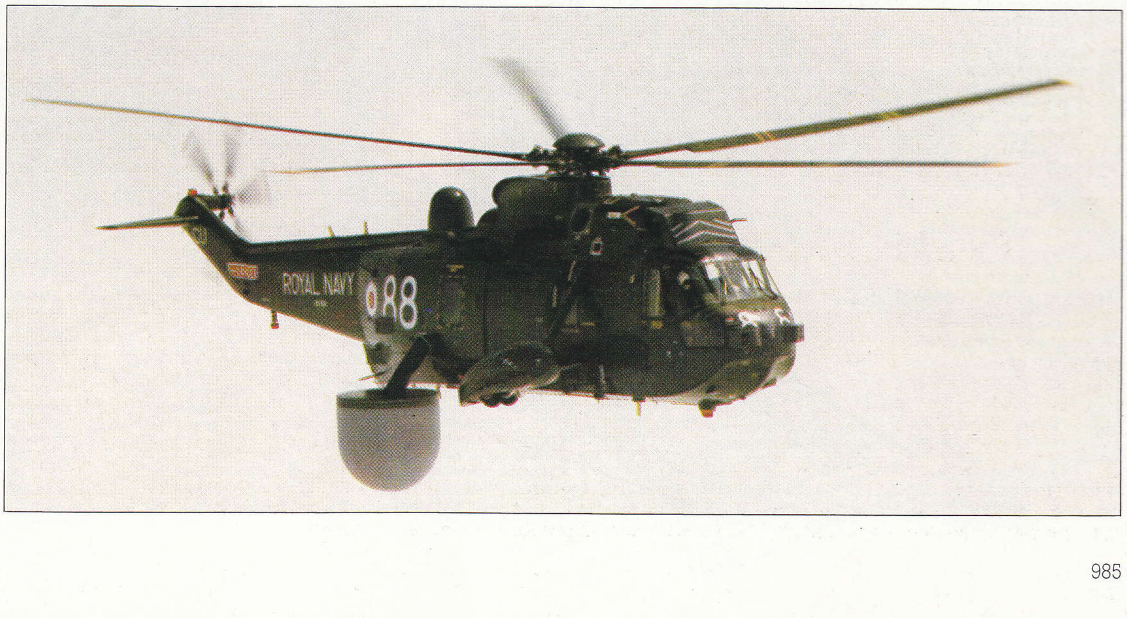


Seen over the coast of Grampian (formerly Morayshire), this Shackleton AEW.Mk 2 still soldiers on with RAF No. 8 Sqn, though the unit is now relocated at RAF Waddington and is working up with the new-generation Nimrod AEW.Mk 3.

UK

Westland Sea King AEW

In the early 1950s the development of AEW radar triggered the introduction of many types of what were called 'radar picket' aircraft to perform a surveillance function. Among them was the big Sikorsky S-56 helicopter, the HR2S-1W version of 1957 being equipped with an APS-20E radar in a giant swollen chin radome. In 1966 the impoverished UK was forced to look at the same idea of a surveillance helicopter when the government of the day terminated all future Royal Navy carriers and announced fixed-wing



Still awaiting a mark number (AEW.Mk 6 would be logical), the Westland AEW Sea King was proposed six years ago but refused funding. After the Falklands had been occupied a crash programme was allowed, two HAS.Mk 2s (XV650 and 651) being fitted out with Thorn-EMI Searchwater radars.

airpower at sea would be run down to nothing. AEW protection of the fleet was a blindingly obvious requirement, but the planners decided the Royal Navy would never have to operate outside the range of the old Kinloss-based Shackletons or the helpful US Navy's carriers. The carefully studied proposal for an AEW version of the Westland Sea King was thus rejected. The crass shortsightedness of this decision was obvious even to the officials when British ships began to be sunk in the South Atlantic in April 1982. Accordingly a crash programme was organized, and in just 11 weeks Westland and their suppliers produced the **Westland Sea King AEW.** (It still has not been allocated a mark number). A Thorn-EMI Searchwater radar, basically the same as that in the BAe Nimrod MR.Mk 2, is installed in the centre fuselage with the aerial in a kettledrum radome kept in shape by internal inflation. This radome is normally aligned towards the rear fuselage on the right side, but for use it is swung down through 90° to have a clear view below the helicopter. The radar required modification to provide reliable indication of wave-skimming aircraft, but is now believed to provide good protection out to a radius of about 96 km (60 miles). The first two urgently modified AEW helicopters were former Sea King HAS.Mk 2 ASW machines XV650 and 651, and they went out to the South Atlantic aboard HMS *Illustrious* in August 1982. In 1983 trials began with an improved installation incorporating a Cossor Type 3570 IFF interrogator, and in 1984 a further six helicopters, previously of the Sea King HAR.Mk 3 search and rescue type, were reported to be undergoing conversion to this standard for deployment aboard RN ships.

Specification

Westland Sea King AEW

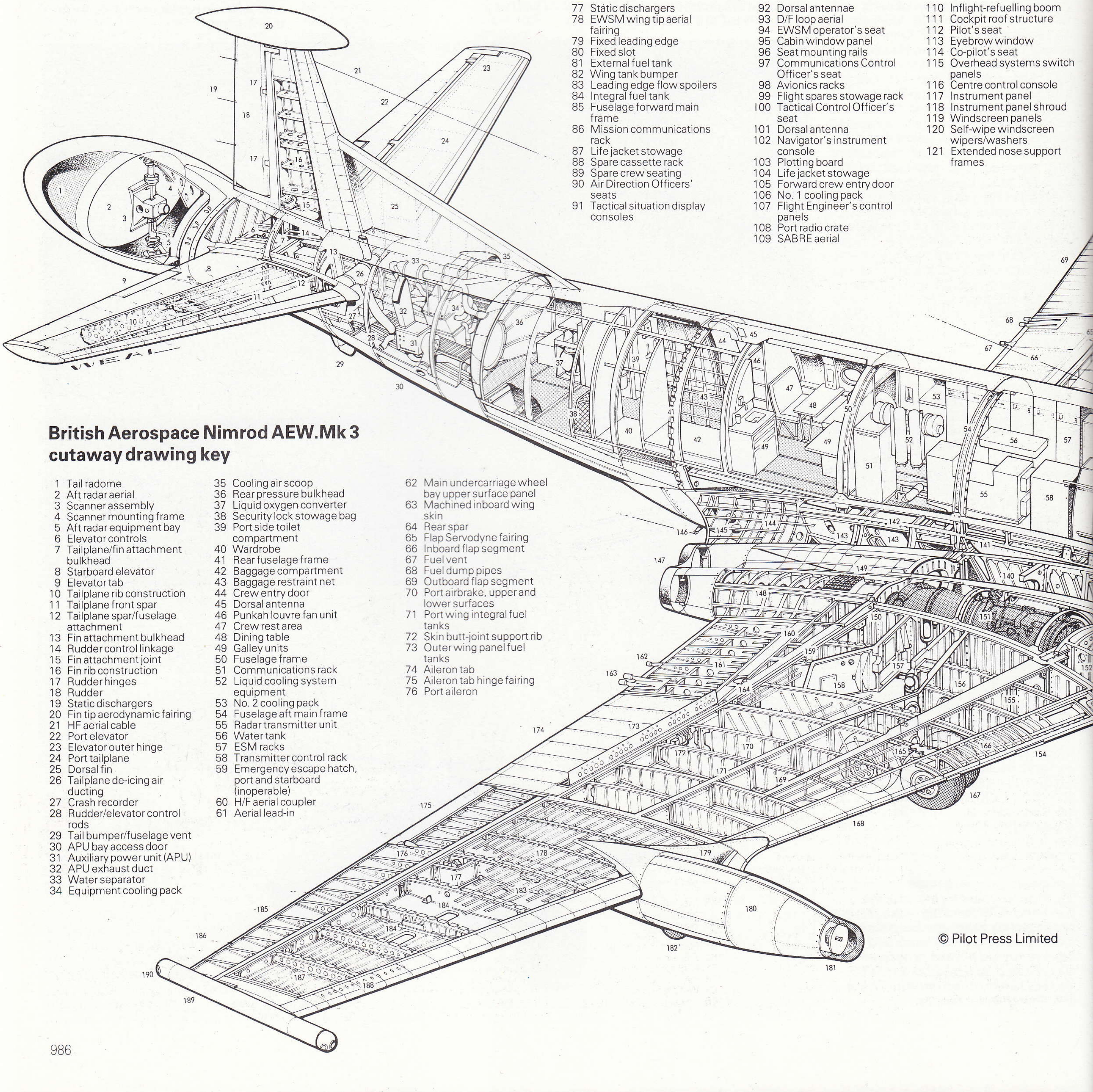
Type: shipboard AEW helicopter

Powerplant: two 1,660-shp (1238-kW) Rolls-Royce Gnome H.1400-1 turboshafts

Performance: normal transit speed about 201 km/h (125 mph); hovering ceiling 975 m (3,200 ft); range with standard fuel 1230 km (764 miles); endurance 3 hours 45 minutes on station at 370-km (230-miles) radius

Weights: empty about 6124 kg (13,500 lb); maximum take-off 9525 kg (21,000 lb)

Dimensions: main rotor diameter 18.90 m (62 ft 0 in); length, excluding rotors 17.01 m (55 ft 9¾ in); height overall 5.13 m (16 ft 10 in); main rotor disc area 280.47 m² (3,019 sq ft)



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British Aerospace Nimrod AEW.Mk 3 cutaway drawing key

1 Tail radome
2 Aft radar aerial
3 Scanner assembly
4 Scanner mounting frame
5 Aft radar equipment bay
6 Elevator controls
7 Tailplane/fin attachment bulkhead
8 Starboard elevator
9 Elevator tab
10 Tailplane rib construction
11 Tailplane front spar
12 Tailplane spar/fuselage attachment
13 Fin attachment bulkhead
14 Rudder control linkage
15 Fin attachment joint
16 Fin rib construction
17 Rudder hinges
18 Rudder
19 Static dischargers
20 Fin tip aerodynamic fairing
21 HF aerial cable
22 Port elevator
23 Elevator outer hinge
24 Port tailplane
25 Dorsal fin
26 Tailplane de-icing air ducting
27 Crash recorder
28 Rudder/elevator control rods
29 Tail bumper/fuselage vent
30 APU bay access door
31 Auxiliary power unit (APU)
32 APU exhaust duct
33 Water separator
34 Equipment cooling pack
35 Cooling air scoop
36 Rear pressure bulkhead
37 Liquid oxygen converter
38 Security lock stowage bag
39 Port side toilet compartment
40 Wardrobe
41 Rear fuselage frame
42 Baggage compartment
43 Baggage restraint net
44 Crew entry door
45 Dorsal antenna
46 Punkah louvre fan unit
47 Crew rest area
48 Dining table
49 Galley units
50 Fuselage frame
51 Communications rack
52 Liquid cooling system equipment
53 No. 2 cooling pack
54 Fuselage aft main frame
55 Radar transmitter unit
56 Water tank
57 ESM racks
58 Transmitter control rack
59 Emergency escape hatch, port and starboard (inoperable)
60 H/F aerial coupler
61 Aerial lead-in
62 Main undercarriage wheel bay upper surface panel
63 Machined inboard wing skin
64 Rear spar
65 Flap Servodyne fairing
66 Inboard flap segment
67 Fuel vent
68 Fuel dump pipes
69 Outboard flap segment
70 Port airbrake, upper and lower surfaces
71 Port wing integral fuel tanks
72 Skin butt-joint support rib
73 Outer wing panel fuel tanks
74 Aileron tab
75 Aileron tab hinge fairing
76 Port aileron
77 Static dischargers
78 EWSM wing tip aerial fairing
79 Fixed leading edge
80 Fixed slot
81 External fuel tank
82 Wing tank bumper
83 Leading edge flow spoilers
84 Integral fuel tank
85 Fuselage forward main frame
86 Mission communications rack
87 Life jacket stowage
88 Spare cassette rack
89 Spare crew seating
90 Air Direction Officers' seats
91 Tactical situation display consoles
92 Dorsal antennae
93 D/F loop aerial
94 EWSM operator's seat
95 Cabin window panel
96 Seat mounting rails
97 Communications Control Officer's seat
98 Avionics racks
99 Flight spares stowage rack
100 Tactical Control Officer's seat
101 Dorsal antenna
102 Navigator's instrument console
103 Plotting board
104 Life jacket stowage
105 Forward crew entry door
106 No. 1 cooling pack
107 Flight Engineer's control panels
108 Port radio crate
109 SABRE aerial
110 Inflight-refuelling boom
111 Cockpit roof structure
112 Pilot's seat
113 Eyebrow window
114 Co-pilot's seat
115 Overhead systems switch panels
116 Centre control console
117 Instrument panel
118 Instrument panel shroud
119 Windscreen panels
120 Self-wipe windscreen wipers/washers
121 Extended nose support frames

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UK

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Intended to fulfil a similar function to that undertaken by the Boeing E-3 Sentry, the **BAe Nimrod AEW.Mk 3** is made instantly recognizable by its bulbous 'spring onion' radomes at nose and tail, containing Marconi pulse-Doppler radar antennae providing 360° scanning coverage. The type is based on the maritime patrol Nimrod MK.Mk 1, and present planning anticipates the delivery of 11 production conversions to the Royal Air Force. The project has recently suffered from some delays with the unfortunate result that the in-service date has slipped by several months.

Inevitably, the Nimrod AEW.Mk 3's sophistication has meant that the development process has been quite protracted, initial airborne testing of the radar being accomplished by a suitably modified Comet 4C which first flew in this form in June 1977. This was later joined by three further development specimens of the Nimrod AEW.Mk 3, the second example of which was assigned to testing the complete radar, IFF (Identification Friend or Foe) and passive ELINT receiver equipment with effect from July 1980 when it made its maiden flight. It was originally hoped to deliver the first production-configured aircraft to RAF Waddington in mid-1983 so that crew trai
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Integral fuel tank
Fuselage forward main frame
Mission communications rack
Life jacket stowage
Spare cassette rack
Spare crew seating
Air Direction Officers' seats
Tactical situation display consoles

92 Dorsal antennae
93 D/F loop aerial
94 EWSM operator's seat
95 Cabin window panel
96 Seat mounting rails
97 Communications Control Officer's seat
98 Avionics racks
99 Flight spares stowage rack
100 Tactical Control Officer's seat
101 Dorsal antenna
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103 Plotting board
104 Life jacket stowage
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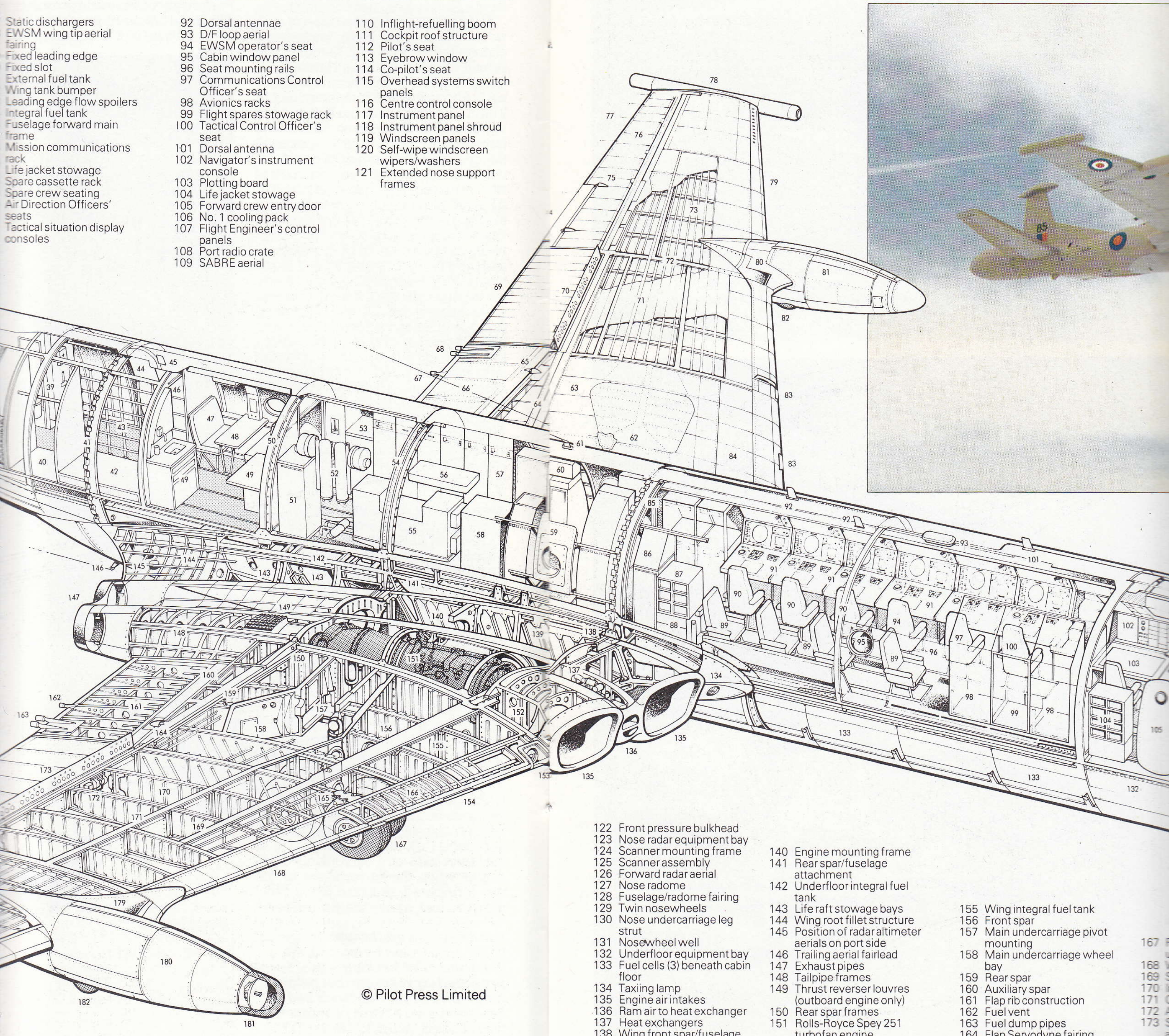

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122 Front pressure bulkhead
123 Nose radar equipment bay
124 Scanner mounting frame
125 Scanner assembly
126 Forward radar aerial
127 Nose radome
128 Fuselage/radome fairing
129 Twin nosewheels
130 Nose undercarriage leg strut
131 Nosewheel well
132 Underfloor equipment bay
133 Fuel cells (3) beneath cabin floor
134 Taxiing lamp
135 Engine air intakes
136 Ram air to heat exchanger
137 Heat exchangers
138 Wing front spar/fuselage attachment
139 Inboard engine bay (engine omitted)
140 Engine mounting frame
141 Rear spar/fuselage attachment
142 Underfloor integral fuel tank
143 Life raft stowage bays
144 Wing root fillet structure
145 Position of radar altimeter aerials on port side
146 Trailing aerial fairlead
147 Exhaust pipes
148 Tailpipe frames
149 Thrust reverser louvres (outboard engine only)
150 Rear spar frames
151 Rolls-Royce Spey 251 turbofan engine
152 Intake duct fairing
153 Landing lamp
154 Leading edge flow spoilers
155 Wing integral fuel tank
156 Front spar
157 Main undercarriage pivot mounting
158 Main undercarriage wheel bay
159 Rear spar
160 Auxiliary spar
161 Flap rib construction
162 Fuel vent
163 Fuel dump pipes
164 Flap Servodyne fairing
165 Wing skin joint strap
166 Leading edge de-icing air ducting
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In service the Nimrod AEW.Mk 3 is expected to carry a crew of nine, comprising a pilot, co-pilot and flight engineer plus one communications officer and up to five AEW systems operators. In addition to the primary radar system, this variant of the Nimrod also features a most extensive collection of communications equipment, including LF, HF and UHF radio as well as VHF/UHF secure voice link and secure digital data links.

Specification

BAe Nimrod AEW.Mk 3

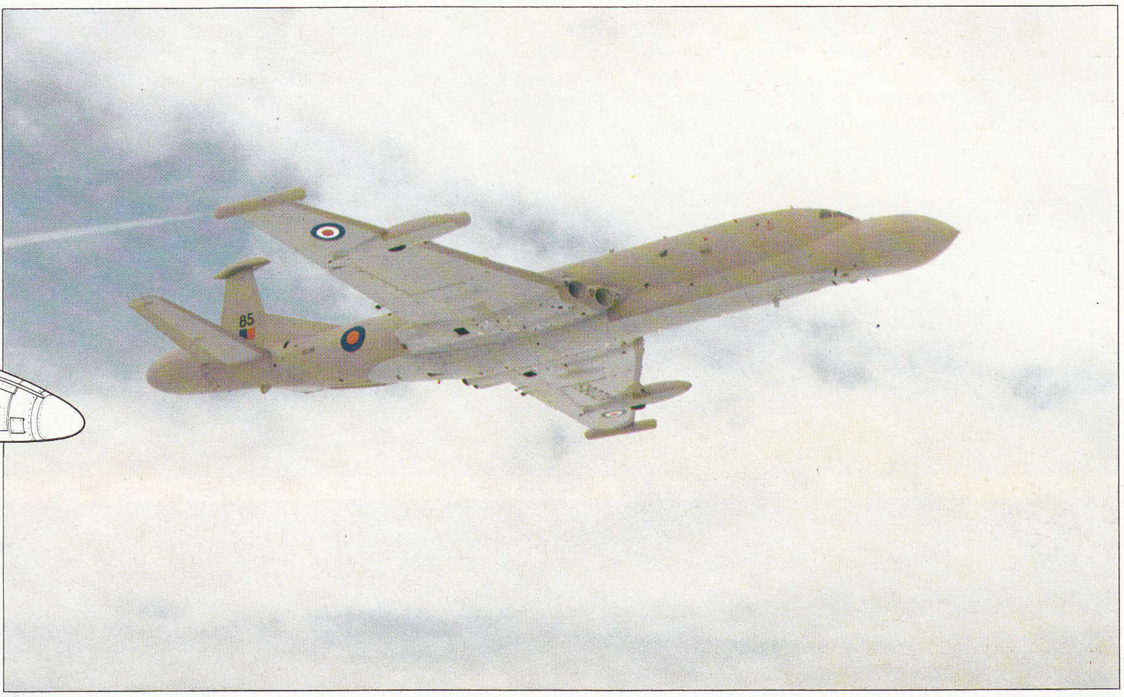
Type: airborne warning and control system platform

Powerplant: four 5507-kg (12,140-lb) thrust Rolls-Royce RB.168-20 Spey Mk 250 turbofans

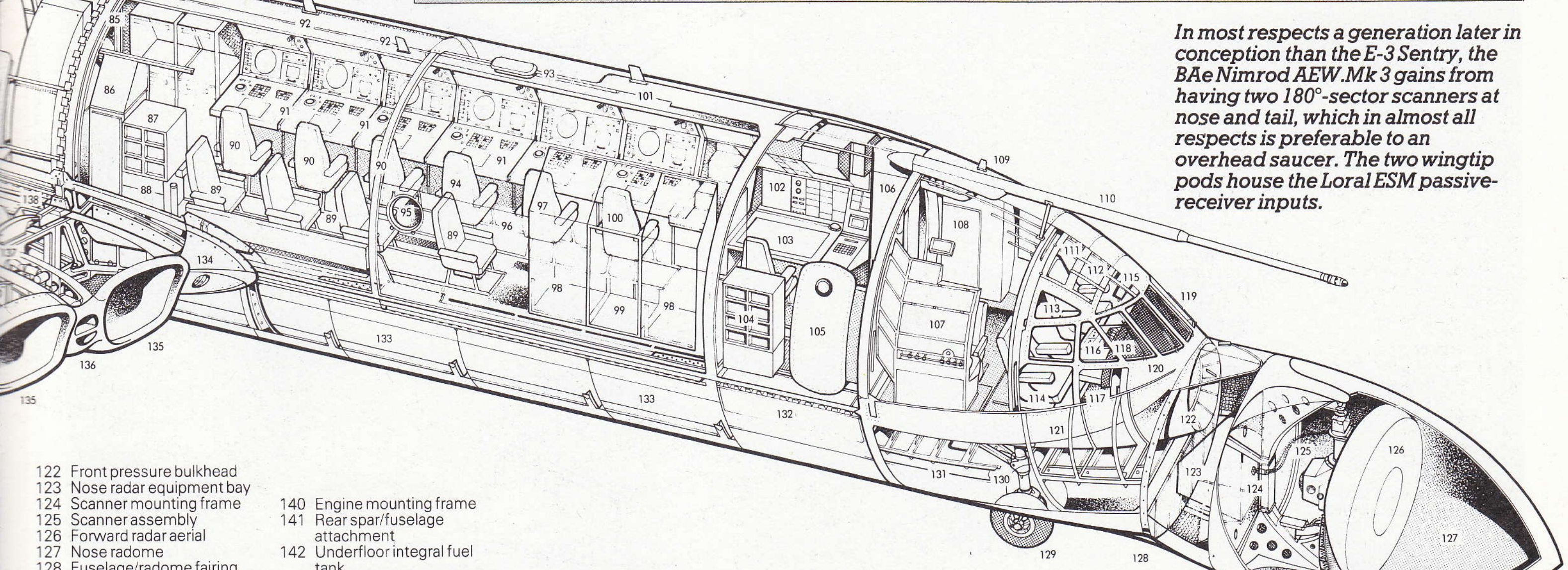
Performance: maximum speed about 925 km/h (575 mph) at altitude; service ceiling about 12800 m (42,000 ft); endurance about 12 hours

Weight: maximum take-off about 80287 kg (177,000 lb)

Dimensions: span 35.08 m (115 ft 1 in); length 41.90 m (137 ft 5.5 in); height 10.06 m (33 ft 0 in); wing area 197.04 m^2 (2,121 sq ft)



In most respects a generation later in conception than the E-3 Sentry, the BAe Nimrod AEW.Mk 3 gains from having two 180°-sector scanners at nose and tail, which in almost all respects is preferable to an overhead saucer. The two wingtip pods house the Loral ESM passive-receiver inputs.



122 Front pressure bulkhead
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159 Rear spar
160 Auxiliary spar
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162 Fuel vent
163 Fuel dump pipes
164 Flap Servodyne fairing
165 Wing skin joint strap
166 Leading edge de-icing air ducting
167 Four-wheel main undercarriage bogie
168 Wing leading edge
169 Semi-span wing spar
170 Integral fuel tanks
171 Centre spar
172 Airbrake operating jack
173 Starboard airbrake (upper and lower surface)
174 Outboard flap segment
175 Aileron tab
176 Aileron hinge fairing
177 Aileron hinge control linkage
178 Wing stringers
179 Fixed slot
180 External fuel tank
181 Weather radar
182 Wing tank bumper
183 Outboard fuel tank bays
184 Fuel tank access panels
185 Starboard aileron
186 Static dischargers
187 Outer wing panel structure
188 Vortex generators
189 EWSM starboard wing tip aerial fairing
190 EWSM aerials

Hawkeye in Action

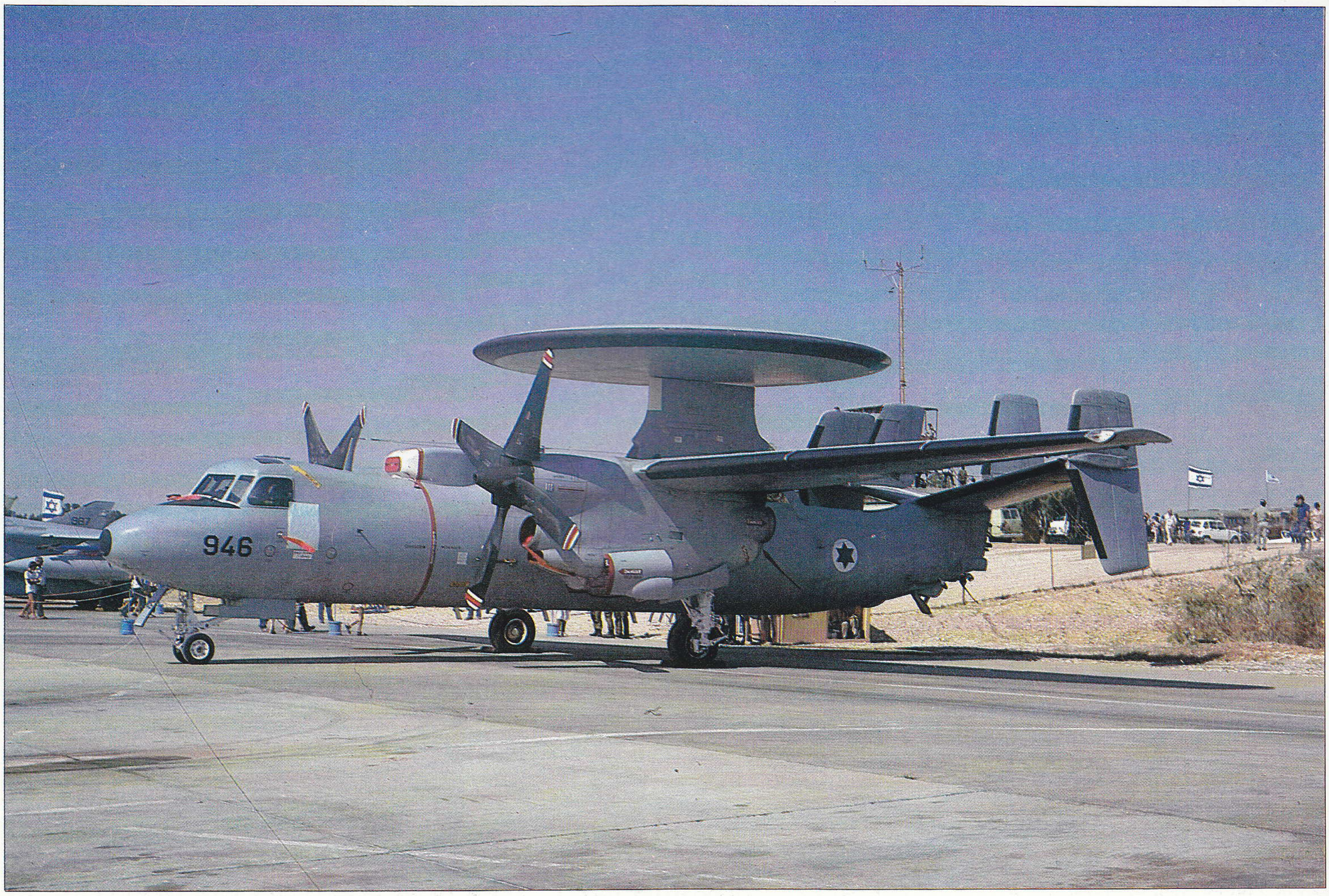
Since its introduction in 1964, the Grumman E-2 Hawkeye has proved to be one of the most effective of AEW and airborne control aircraft. In its E-2C form the aircraft is packed with state-of-the-art electronic and detection gear, and has proved its worth decisively in the hands of the Israeli air force over the Lebanon.

On the ground a folded Grumman E-2C Hawkeye looks more like a tightpacked suitcase than an aeroplane. Before flight it unfolds like a butterfly emerging from a chrysalis case, its long wings rotating into the flight position and the strange saucer-like radar rotodome being raised high above the fuselage on a tall extendable pylon. Readied for flight the E-2 emerges for what it is: an efficient high-wing monoplane with two turboprop engines, its only odd feature apart from the rotodome being the squat four-finned tail, designed to fit into the severely small box-like space needed for parking inside an aircraft-carrier hangar. It is far from obvious that this aircraft is internally one of the most complex ever built, or that though it looks rather like a commuter airliner it is strong enough to be fired off a steam catapult and slammed on to a pitching deck in a no-flare arrested landing.

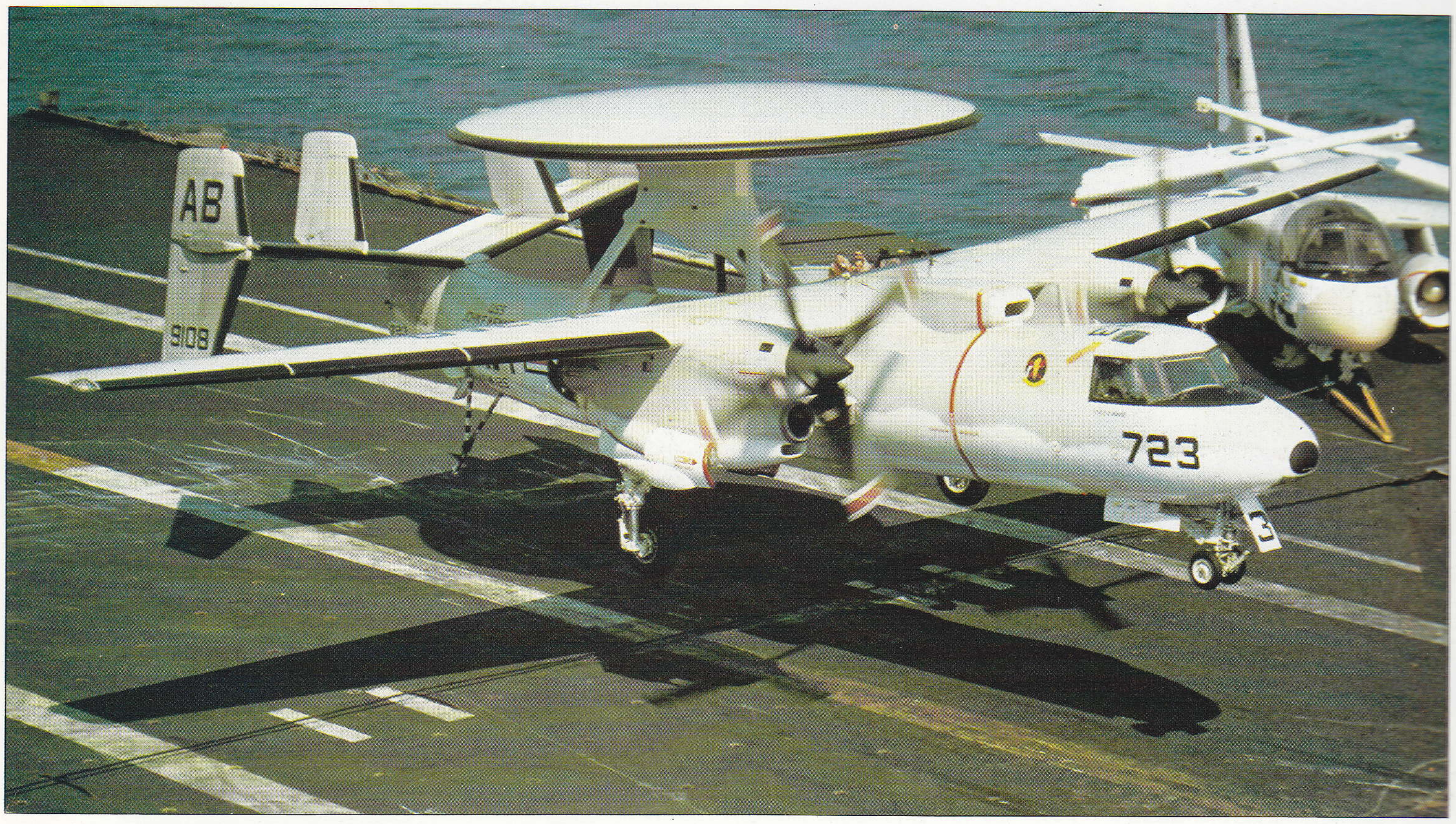
The Hawkeye was the first aircraft in the world designed from the outset as an AEW (airborne early warning) platform. The original E-2A of 1961 was the first aircraft ever to have the ability to detect and track overwater targets automatically, even in the presence of heavy clutter or deliberate hostile jamming. Thus the mission crew could be cut to only three operators, the aircraft itself being flown by a pilot and co-pilot up front. These three operators have from the start controlled five tons of radars, power and cooling supplies, computers and data-processing systems, special sensors, and special communications.

The E-2A began life with the impressive APS-96 radar, transmitting and receiving through the 7.32-m (24-ft) rotodome mounted high above the middle of the fuselage and rotating to see over the entire 360° around the aircraft. Special pulse-compression techniques were used to cut down the clutter reflected from sea waves and bad weather. The 59 examples of this model entered US Navy service as the standard carrierborne surveillance aircraft from 1964 onwards. It was soon found that the hardwired computer drum-memory could not be reprogrammed without costly and protracted physical alteration, and so all Hawkeyes were modified to the E-2B standard with a Litton micro-electronic computer with a solid-state core memory. This could be reprogrammed just by changing the magnetic tape. The result was a fine aircraft which, along with the E-2A, served impressively over South East Asia, both in defending against intercepting MiGs and in controlling attack missions by all kinds of friendly fighters, vectoring aircraft back to base in bad weather and ensuring that needy aircraft could take on fuel from a tanker even in the most difficult low-visibility conditions.

This campaign demonstrated that US Navy aircraft might have to operate over land; and in any case Grumman could see the development of foreign markets in which the overland mission would be the dominant factor. Accordingly Grumman and General Electric prepared a scheme for a completely new third-generation Hawkeye, and the US Navy agreed to fund its development as the E-2C. This has the entirely new radar, computer processing and display consoles packaged into the same airframe in one of the cleverest aircraft engineering programmes in history. At first the radar was the APS-120, because this could be configured in short order to provide an interim overland capability, though in this mode manual operation is needed. The APS-120 provided built-in clutter rejection circuits from the outset. But it still failed to match the potential of 1970s electronic technology, and after a major development programme the APS-125 radar was installed together with its integral ARPS (ad-



The three-figure Modex-style number on this Israeli Grumman E-2C gives little away. The Israelis are deeply security-conscious, and carefully protect the identities of combat aircraft, their operating units and base locations. But over the Bekaa Valley the E-2C's value was obvious.



Tail code AB shows a Hawkeye of the US Navy Atlantic Fleet, in this case Air Wing CVW-1 embarked aboard USS John F. Kennedy. *The E-2C has BuAer no. 159108, the 15th to be built. The squadron is VAW-125 'The Torchbearers'. It has just made an arrested landing, engines at full power for a bolter.*

vanced radar processing system) which, using digital techniques throughout, can eliminate all (not just most) of the stationary land noise, clutter and false target reflections.

When it is realized that this means unfailing detection of all moving targets, together with simultaneous recognition and elimination of the reflections from waves, blown sea spray, leaves and growing crops in a high wind, and all other 'false' moving targets, it can be seen how far the ARPS has come from the early AEW radars. It can thus give a sharp and clear picture of 250 to 300 targets, and simultaneously handle more than 40 interceptions. The rotodome aerial contains batteries of Yagi-type antennae, looking rather like TV aerials, to provide sum and difference signals on each rotation of the dish, which occurs once every 10 seconds. The same array also provides IFF (identification friend or foe) signals, giving instant identification of all hostile targets. The one exception to the rejection of all signals from fixed targets is that in the maritime surveillance mode the radar detects ships whether moving or at anchor. Target range depends on its size, but even small patrol craft, where only the tips of masts or aerials project more than a few feet above the sea, have been detected at ranges greater than 160 km (100 miles).

One of the difficulties with any radar surveillance platform is that it betrays its presence in the strongest possible way, by broadcasting powerful radar signals in all directions. It is easy to design missiles that home automatically on to the exact radar signals emitted by such aircraft, and how aircraft such as the E-2C, Boeing E-3 Sentry and other AWACS platforms defend themselves is a highly classified subject. Clearly, as they are the most expensive and individually vital aircraft in the sky, means must be provided to protect them from instant destruction as soon as they switch on the radar. But it helps if they can also serve a useful function whilst remaining electronically silent, and the E-2C now has an added PDS (passive detection system). Such a system is absent from the E-3 family of aircraft, despite their much greater size and cost.

When the PDS is in operation it automatically detects, locates and analyses every electronic signal received at the aircraft from all sources (or, if necessary, from only a limited arc of the compass enclosing the hostile land mass or fleet). Each signal is automatically compared with those stored in an on-board file of known emitters, and especially with known hostile radars. In this fashion the identity and location of known hostile emitters can be plotted in real time. Thus, if an enemy mobile SAM vehicle with a radar suddenly unmasks in the path of a friendly attacking aircraft, the pilot of that individual aircraft can be alerted and given precise guidance on how to steer to avoid the new threat, within seconds of it being discovered. This can be done without either the attacking aircraft or the Hawkeye sending out any signal except the radio message. This message can be coded in such a way as to preclude the possibility of enemy eavesdropping or jamming.

Avoidance of jamming is also one of the

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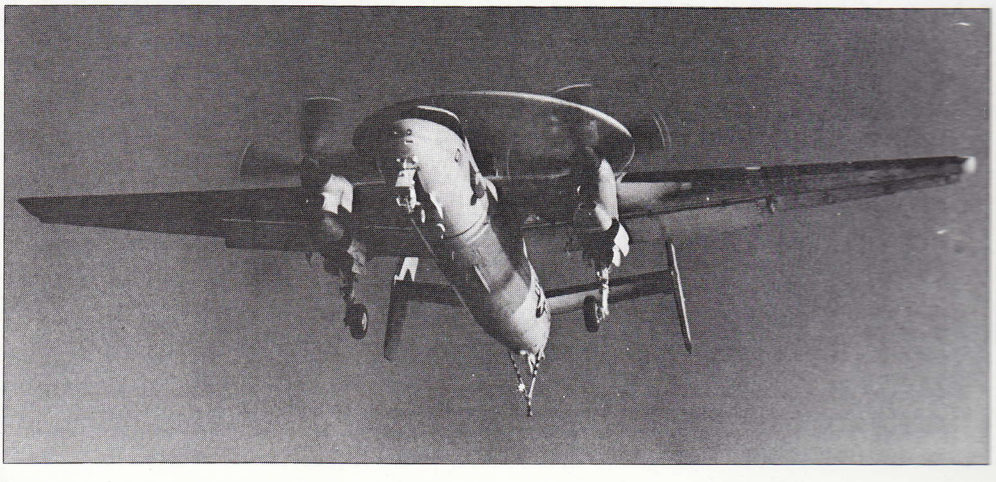
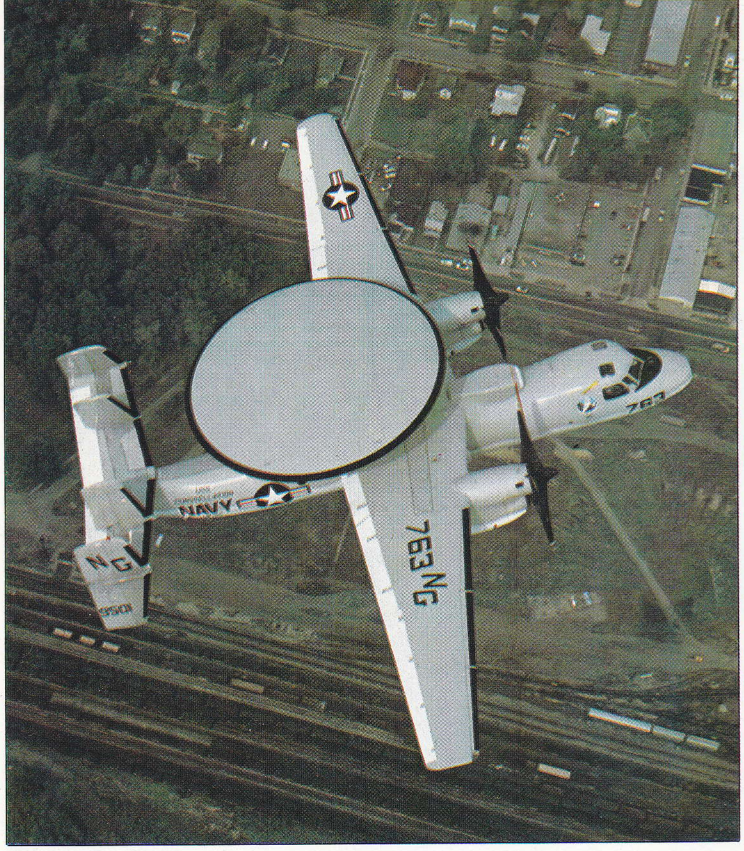
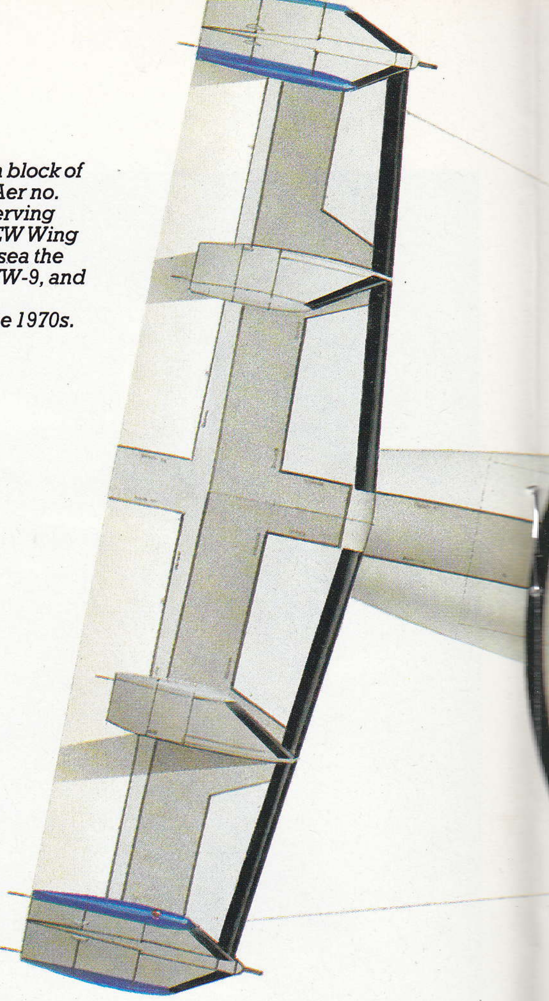
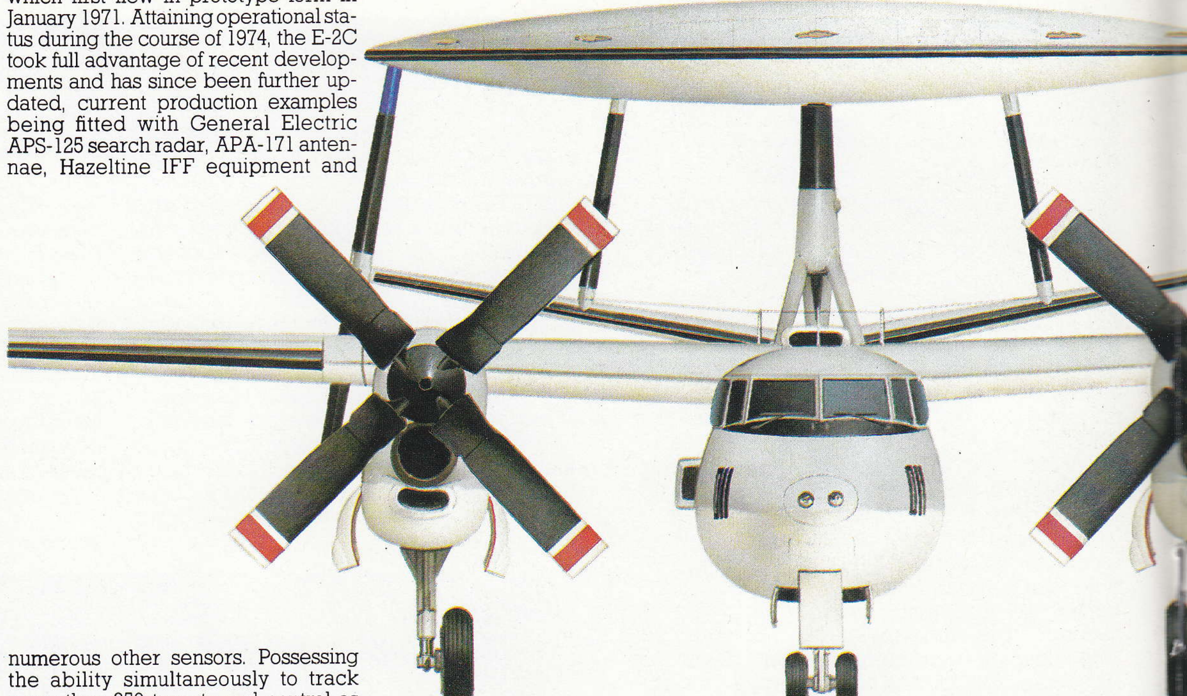
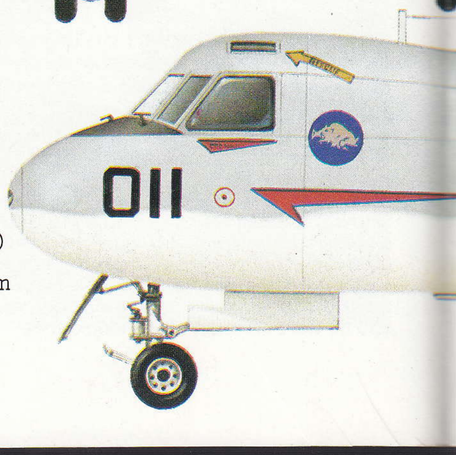


Coming in for an arrested landing the Hawkeye – an early example – shows its wide-span wings with area-increasing flaps and drooping ailerons for a slow approach. Despite its size the Hawkeye has to meet all Navy requirements for brutal cat launches and no-flare landings on moving decks.









One of the third production block of E-2C Hawkeye aircraft, BuAer no. 159501 is pictured whilst serving with VAW 126 of Carrier AEW Wing 12 based at Norfolk, Va. At sea the squadron is attached to CVW-9, and was embarked upon USS Constellation *throughout the 1970s.*

USA

Grumman E-2 Hawkeye

First flown in prototype form as the **W2F-1** during April 1960, the initial production variant of the **Grumman E-2 Hawkeye** was the **E-2A**. This entered US Navy service during January 1964 although it was not deployed operationally until October 1965 when the first detachment embarked aboard the USS *Kitty Hawk*.

Fitted with General Electric APS-96 search radar operating in conjunction with the APS-143 antennae group located in the distinctive pancake-shaped radome, the E-2A model represented a very real improvement over the Grumman E-1B Tracer, benefitting significantly from the adoption of turboprop engines which resulted in far superior performance.

Three prototype aircraft were followed by 56 production examples of the E-2A, and these eventually saw service with about a dozen US Navy AEW squadrons, generally operating only from the so-called 'super carriers' of the 'Forrestal' and succeeding classes. Two of the prototypes were later converted to **C-2A** Greyhound transport aircraft while two early production specimens became **TE-2A** aircraft and were assigned solely to training duties.

The great strides being made in the fields of avionics and computer technology during the early 1960s resulted in the appearance of the **E-2B** derivative, which featured a Litton L-304 computer to process and display data originating from the primary detection sensors, which remained basically unchanged. Flying qualities were also improved through the provision of enlarged outer fins, a total of 51 E-2As being progressively modified to E-2B configuration with the first examples rejoining Atlantic Fleet units during 1970.

Continuing progress in miniaturization of avionics and electronics equipment, allied to the dawn of the microchip age, brought forth what can only be described as the definitive Hawkeye, this being the **E-2C** model which first flew in prototype form in January 1971. Attaining operational status during the course of 1974, the E-2C took full advantage of recent developments and has since been further updated, current production examples being fitted with General Electric APS-125 search radar, APA-171 antennae, Hazeltine IFF equipment and numerous other sensors. Possessing the ability simultaneously to track more than 250 targets and control as many as 30 airborne interceptors, the E-2C ranks as one of the most effective AEW aircraft extant, and production for the US Navy is now nearing the 100 mark whilst a number of aircraft have also been supplied to the air arms of Israel and Japan.

Specification

Grumman E-2C Hawkeye

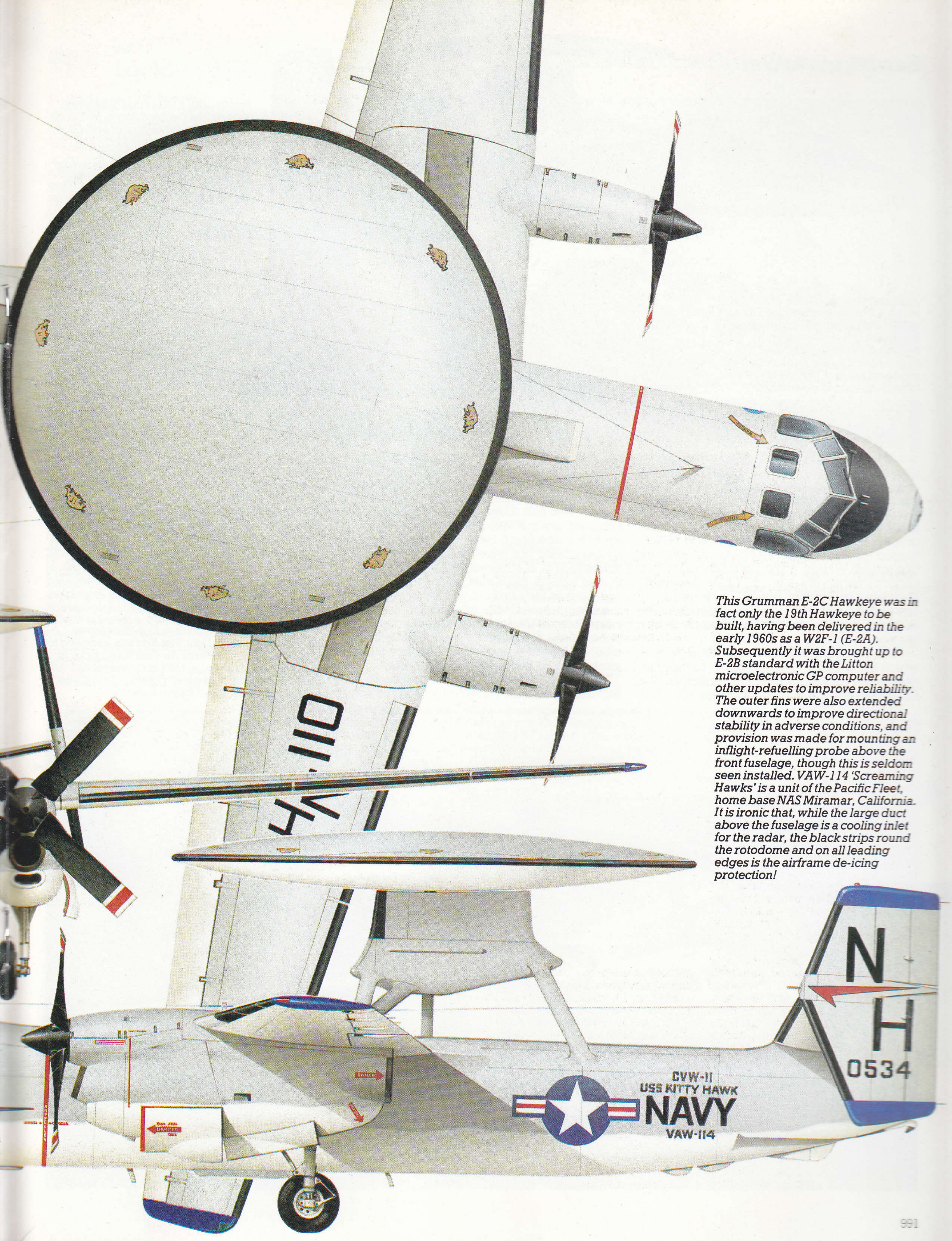
Type: airborne early warning and control platform

Powerplant: two 4,910-shp (3663-ekW) Allison T56-A-425 turboprops

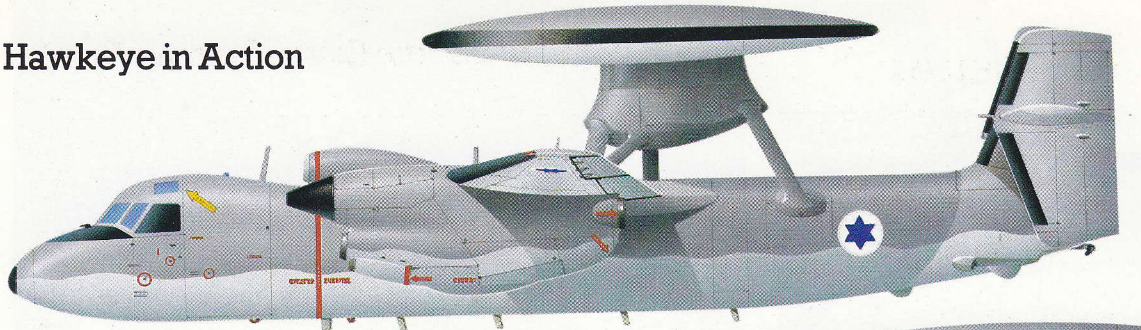
Performance: maximum speed 602 km/h (374 mph); service ceiling 9380 m (30,800 ft); endurance 6 hours; range 2583 km (1,605 miles) for ferrying

Weights: empty 17091 kg (37,678 lb); maximum take-off 23392 kg (51,569 lb)

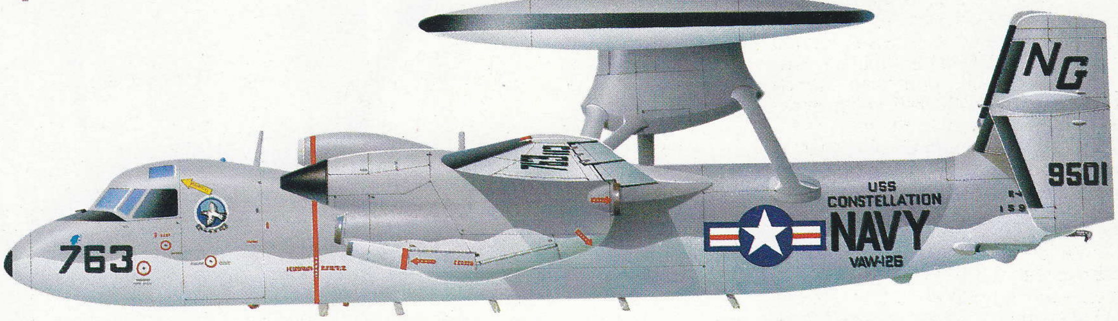
Dimensions: span 24.56 m (80 ft 7 in); length 17.54 m (57 ft 7 in); height 5.58 m (18 ft 4 in); wing area 65.03 m^2 (700 sq ft)



This Grumman E-2C Hawkeye was in fact only the 19th Hawkeye to be built, having been delivered in the early 1960s as a W2F-1 (E-2A). Subsequently it was brought up to E-2B standard with the Litton microelectronic GP computer and other updates to improve reliability. The outer fins were also extended downwards to improve directional stability in adverse conditions, and provision was made for mounting an inflight-refuelling probe above the front fuselage, though this is seldom seen installed. VAW-114 'Screaming Hawks' is a unit of the Pacific Fleet, home base NAS Miramar, California. It is ironic that, while the large duct above the fuselage is a cooling inlet for the radar, the black strips round the rotodome and on all leading edges is the airframe de-icing protection!



Profile of an E-2C of the Israeli Heyl ha'Avir, the Defence Force/Air Force. Originally the standard of build was virtually identical to the US Navy aircraft (but without TRAC-A modification). Today several Israeli electronic items have been added, including some of Elta make.



Another view of E-2C no. 159501, showing the Modex number 763 and tail code NG both repeated above the starboard (right) wing. The wings fold on skewed hinges so that they lie horizontally on each side of the squat tail unit, the rotodome also retracting slightly downwards.

reasons behind the 1983 introduction of TRAC-A (total radiation aperture control antenna), which will probably be retrofitted to the Hawkeye now in serve. This not only offset increased jamming threats but, by cutting down the unwanted sidelobes in the emission from the main radar, makes better use of the radiated power and gives an improved picture. It is cryptically stated that radar range is to be extended (presumably by TRAC-A), but whether this means adding a difficult OTH (over the horizon) capability has not been disclosed. Most airborne radars cannot see beyond the line of sight, and so their range depends not so much on the radar itself as on the height above the Earth's surface.

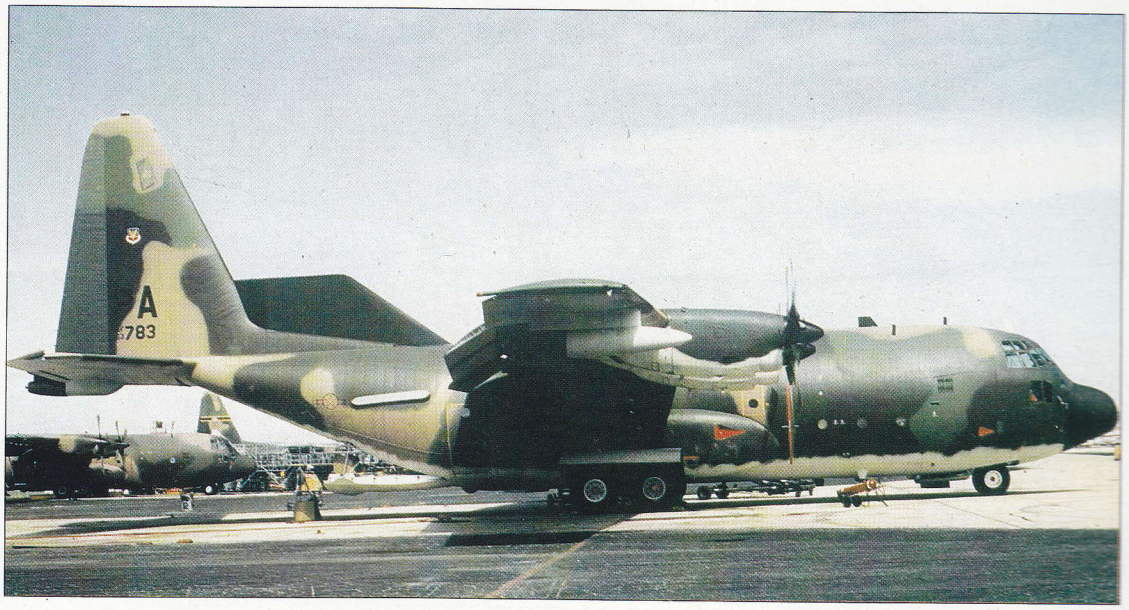
Total US Navy orders cover 102 E-2Cs, of which 78 were in service in 13 carrier air groups in the spring of 1984. The remainder are being delivered at the rate of six per year until the early 1990s, to a final total higher than 102. Israel purchased four, which have proved most valuable during almost incessant war operations. The Heyl ha'Avir (Israeli air force) has stated that it hardly ever sends up its fighters or attack aircraft unless a Hawkeye is on station, and the fact that these aerial watchdogs have survived against numerous hostile MiGs is probably significant. Since they became operational in 1981 tiny Israel has never once been subjected to a surprise or pre-emptive air attack. Indeed, the Syrian MiGs are under surveillance as they taxi out to take off at Damascus-region bases. On the ground the Hawkeye's compact foldable dimensions have been helpful in easing the problem of concealment in forward bases where large non-folding aircraft would certainly be vulnerable.

The next customer was Japan, whose Air Self-Defence Force accepted four in 1982 and is due to receive four more in 1984. These, of course, have not seen action but are serving a vital role in conjunction with Japan's own land-based electronic air-defence system. Egypt, fortunately now more or less at peace with Libya and certainly with no troubles on its eastern frontiers, nevertheless needed an effective AEW and control aircraft for multiplying the effectiveness of its large air force, and has two E-2Cs with more planned. Singapore expects to deploy four from 1985. Biggest customer is likely to be France, whose Armée de l'Air tested two E-2Cs extensively and is expected to announce its decision in 1984.

One of the first four Grumman E-2C Hawkeyes supplied to Japan in 1982. The first was assigned to the Air Self-Defence Force Air Test Wing, prior to becoming operational in 1984 in an integrated defence system. The ground portion of the system is the Hughes-supplied Badge network.

USA

Lockheed EC-130 Hercules



Totally unlike other EC-130E versions, the Coronet Solo II EC-130E variant has replaced various EC-121 models as a dedicated USAF surveillance platform. The longest wavelengths are received by miles of wire rolled out from the pods.

In the number of derivatives which have seen service with the US armed forces, the **Lockheed C-130 Hercules** is almost as prolific as the Boeing C-135. Almost inevitably, the multiplicity of variants has included a number of electronic specialists, some being engaged on the acquisition of intelligence whilst others have undertaken C^3 (Command, Control and Communications) tasks in the vicinity of the battlefield, suitably modified machines seeing extensive service during the course of the Vietnam War.

ELINT variants comprise the **C-130A-II** and the **C-130B-II**, which operated in Europe and South East Asia for many years although all of the survivors are known to have reverted to standard cargo configuration during the early or mid-1970s. More recently, the **EC-130H** electronic warfare version has appeared, this model entering service with the 41st Electronic Countermeasures Squadron at Davis-Monthan AFB, Arizona in April 1982 although relatively little is known about the precise nature of the work undertaken.

As far as the C^3 mission is concerned, the first aircraft to be associated with this was the **C-130E-II** (later redesignated as the **EC-130E**) which was used from Thailand for airborne control of tactical fighter/strike aircraft. At least nine examples of the Hercules were so modified to take the USC-15 C^3 system, but these should not be confused with yet another sub-type which, rather confusingly, uses the same EC-130E designation. The 'second-generation' EC-130E is in fact a most distinctive machine, being instantly identifiable by prominent blade antenna fairings at the forward edge of the fin and beneath each wing. It also carries the modular USC-15 system in the cargo hold, and eight aircraft have been modified to this configuration for service with the Air National Guard.

Two other 'electronic' Hercules sub-types serve with the US Navy, these being the **EC-130G** and **EC-130Q** which are assigned to the mission of maintaining VLF radio contact with the US Navy's large fleet of nuclear-powered and nuclear-armed submarines. Consequently, they feature comprehensive communications equipment and they are expected to remain in use for several more years until the Boeing E-6A becomes available, assuming that this project goes ahead.

Specification

Lockheed EC-130E Hercules

Type: C^3 platform

Powerplant: four 4,050-shp (3020-ekW) Allison T56-A-7 turboprops

Performance: maximum cruising speed 592 km/h (368 mph); range 3895 km (2,420 miles) with 20412 kg (45,000 lb) maximum payload

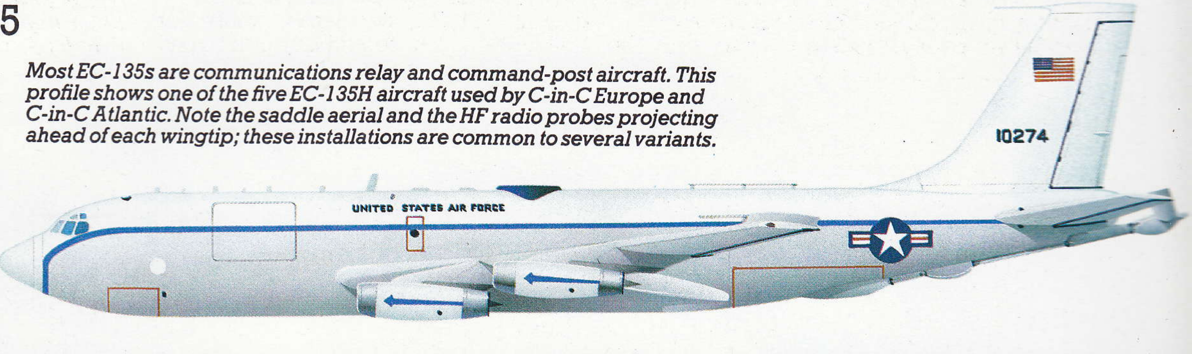
Weights: empty 33064 kg (72,892 lb); maximum take-off not known

Dimensions: span 40.41 m (132 ft 7 in); length 29.79 m (97 ft 9 in); height 11.66 m (38 ft 3 in); wing area 162.12 m^2 (1,745 sq ft)

USA

Boeing EC-135

Most EC-135s are communications relay and command-post aircraft. This profile shows one of the five EC-135H aircraft used by C-in-C Europe and C-in-C Atlantic. Note the saddle aerial and the HF radio probes projecting ahead of each wingtip; these installations are common to several variants.



Though its variants are physically smaller and much lighter than the Boeing 707-320 family, the Boeing C-135 series has proved to be capable of development for a multitude of uses which include an extraordinary variety of missions concerned with reconnaissance and electronic warfare, as well as for operational use as command post and special communications aircraft. Many other members of the C-135 family have been used for research, and the situation has been complicated as there are two basic types of aircraft (one with J57 turbojets and the other with TF33 turbofans). While some have been modified for electronic duties, often several times in succession, others have been built as such from the outset.

In numerical order, the **EC-135A** designation identified six KC-135A tankers rebuilt as radio relay platforms for use in the SAC PACCS (Post Attack Command/Control System), operating from Ellsworth AFB, South Dakota. The TF33-engined **EC-135C** carries a mass of special communications served by various wire, trailing-wire, blade, saddle and pole antennae; 14 were assigned to the 2nd Airborne Command and Control Squadron at Offutt AFB, and to the 4th ACCS at Ellsworth. Four **EC-135G** aircraft, covered in special communications, serve SAC as airborne ICBM launch control centres. They fly with the 4th ACCS, and with the 305th ARW at Grissom AFB. The five **EC-135H** aircraft are part of the national control system, one flying with the 6th ACCS from Langley AFB for the Commander-in-Chief Atlantic and the other four with the 10th ACCS from RAF Mildenhall and other European bases for the US Commander-in-Chief Europe. Likewise the ABNCP (airborne national command post) version for the PACAF (Pacific Air Forces) is the **EC-135J**, four being based at Hickam AFB, Hawaii, with the 9th ACCS. Three basically similar **EC-135K** aircraft serve as the national command posts with TAC (USAF Tactical Air Command) flying with the 8th TDCS from Tinker AFB. Five **EC-135L** aircraft form part of the SAC PACCS global network, identified by red/white radiation hazard striping round the rear fuselage to keep personnel away from their super-powerful radio relay systems. Another five tankers were rebuilt as **EC-135P** command posts to serve with the 6th ACCS in the ABNCP network. Among the many other models are the **EC-135B** and **EC-135N** used for range instrumentation and spacecraft tracking. Reconnaissance sub-types, which include the most grotesquely modified of all, are outside the scope of this survey.

Specification

Boeing EC-135 (baseline figures for J57 aircraft)

Type: various (see above)

Powerplant: four 13,750-lb (6237-kg) thrust Pratt & Whitney J57-59W turbojets

Performance: typical operating speed 800 km/h (497 mph); typical ceiling 11900 m (39,000 ft); range about 8850 km (5,500 miles)

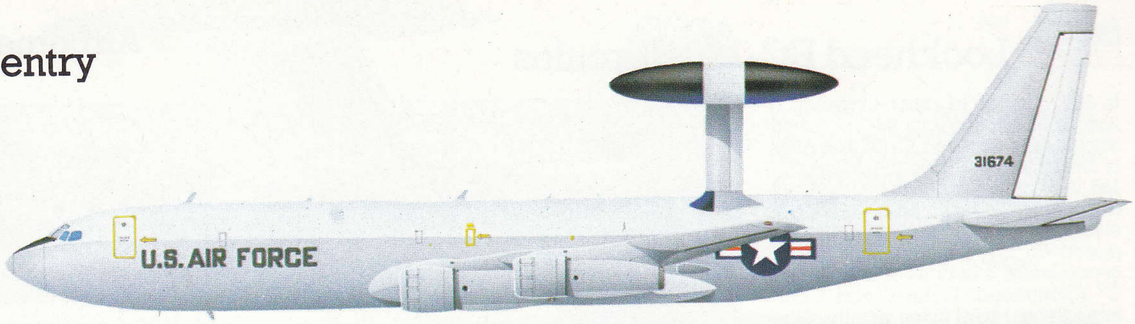
Weights: empty 47000-57000 kg (103,615-125,661 lb); maximum take-off 143338 kg (316,000 lb)

Dimensions: span 39.88 m (130 ft 10 in); length about 40.5 m (133 ft); height (tall fin) 12.69 m (41 ft 8 in); wing area 226 m^2 (2,433 sq ft)

Another view of a regular EC-135H, operated by the USAF 10th Airborne Command and Control Squadron normally based at RAF Mildenhall. All retain their old J57 engines, which smoke profusely on water-injection departures. They retain the air-to-air refuelling receptacle and Flying Boom installation.

USA

Boeing E-3A Sentry



USAF no. 73-1674 was the first E-3A Sentry (apart from the EC-137D test aircraft), and is today known as a Core E-3A because it has the initial form or core without all the later additions.

Originally known by the designation **EC-137D**, the **Boeing E-3 Sentry** is based essentially on the Boeing 707-320B airframe, being instantly identifiable by virtue of the massive rotodome carried on top of two support members above the aft fuselage section. Flown for the first time during 1972, the two prototypes were fitted with different AWACS (Airborne Warning and Control Systems) radars (one by Hughes and the other by Westinghouse), and after competitive evaluation, the latter company's APY-1 radar was selected as being more suitable.

Production specimens of the basic **E-3A** began to enter service with the US Air Force in March 1977, but a further 13 months were to pass before operational status was attained. Since then, the USAF has continued to buy the Sentry in small quantities, close to 30 of the planned total of 46 having now been delivered to the 552nd Airborne Warning and Control Wing at Tinker AFB, Oklahoma.

Progressive updating of those aircraft in USAF service will eventually bring about the disappearance of the E-3A, at least as far as the USAF is concerned, the two primary models then being the **E-3B**, which will in fact be a modernized E-3A, and the **E-3C**. In both cases, the main difference concerns provision of JTIDS (Joint Tactical Information Distribution System), which offers greater security with regard to communications and thus limits the chances of eavesdropping by an enemy. (NATO Sentries will retain the E-3A designation even though they are also to be fitted with JTIDS.)

In addition to those for the USAF, a total of 18 Sentries have been ordered for service with a unique NATO unit at Geilenkirchen, West Germany. About eight of these are now in use and present planning anticipates completion of this order in the latter half of 1985. One other customer for the E-3 is Saudi Arabia, which is to receive five, these differing to a marked degree in that all sensitive equipment is to be removed to limit the risk of compromising what is undoubtedly a most valuable and effective system.

Specification

Boeing E-3A Sentry

Type: airborne warning and control system aircraft

Powerplant: four 9526-kg (21,000-lb) thrust Pratt & Whitney TF33-PW-100/100A turbofans

Performance: maximum speed 853 km/h (530 mph); service ceiling more than 8850 m (29,000 ft); endurance on station 6 hours at a radius of 1610 km (1,000 miles)

Weights: empty about 78019 kg (172,000 lb); maximum take-off 147417 kg (325,000 lb)

Dimensions: span 44.42 m (145 ft 9 in); length 46.61 m (152 ft 11 in); height 12.93 m (42 ft 5 in); wing area 283.35 m^2 (3,050 sq ft)

Right: New Core E-3As at Boeing Aerospace. All these early production aircraft (nos 1-24) entered service with the 552nd AWAC Wing at Tinker AFB, becoming operational in April 1978.

NATO E-3A Sentries have USAF numbers but NATO insignia and official ownership by the Grand Duchy of Luxembourg! What has yet to be fully worked out is the extent to which C-in-C Europe can interoperate them with the RAF Nimrods.

ASSOCIATED GROCERS, Inc.
U.S. AIR FORCE
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U.S. AIR FORCE
U.S. AIR FORCE
USAF

AWACS in Action

Replacing the Lockheed Constellation-based EC-121 in US Air Force service, the Boeing E-3A Sentry AWACS represents a quantum leap in AEW and airborne control capacity. Capable of worldwide deployment at short notice, AWACS (Airborne Warning And Control System) gives US forces a significant advantage in any military confrontation.

After years of apparent neglect in the fulfilment of the airborne early warning mission, USAF capability in this important area received a significant boost in the latter half of the 1970s with the introduction of the Boeing E-3A Sentry. A successful marriage of state-of-the-art radar and electronics technology with what was still essentially a modern airframe, the E-3 represented a fantastic improvement over the 1950s-vintage Lockheed EC-121 which, although it had performed sterling service in Vietnam, had just about reached the end of the line as far as systems updating was concerned and also was clearly no longer capable of a meaningful contribution in the projection of US air power on a global basis.

Almost overnight, the Sentry transformed US capability in this mission, offering truly global mobility by virtue of being jet-powered, whilst the facility for inflight-refuelling meant that it could be deployed virtually anywhere in just a matter of hours should the need arise.

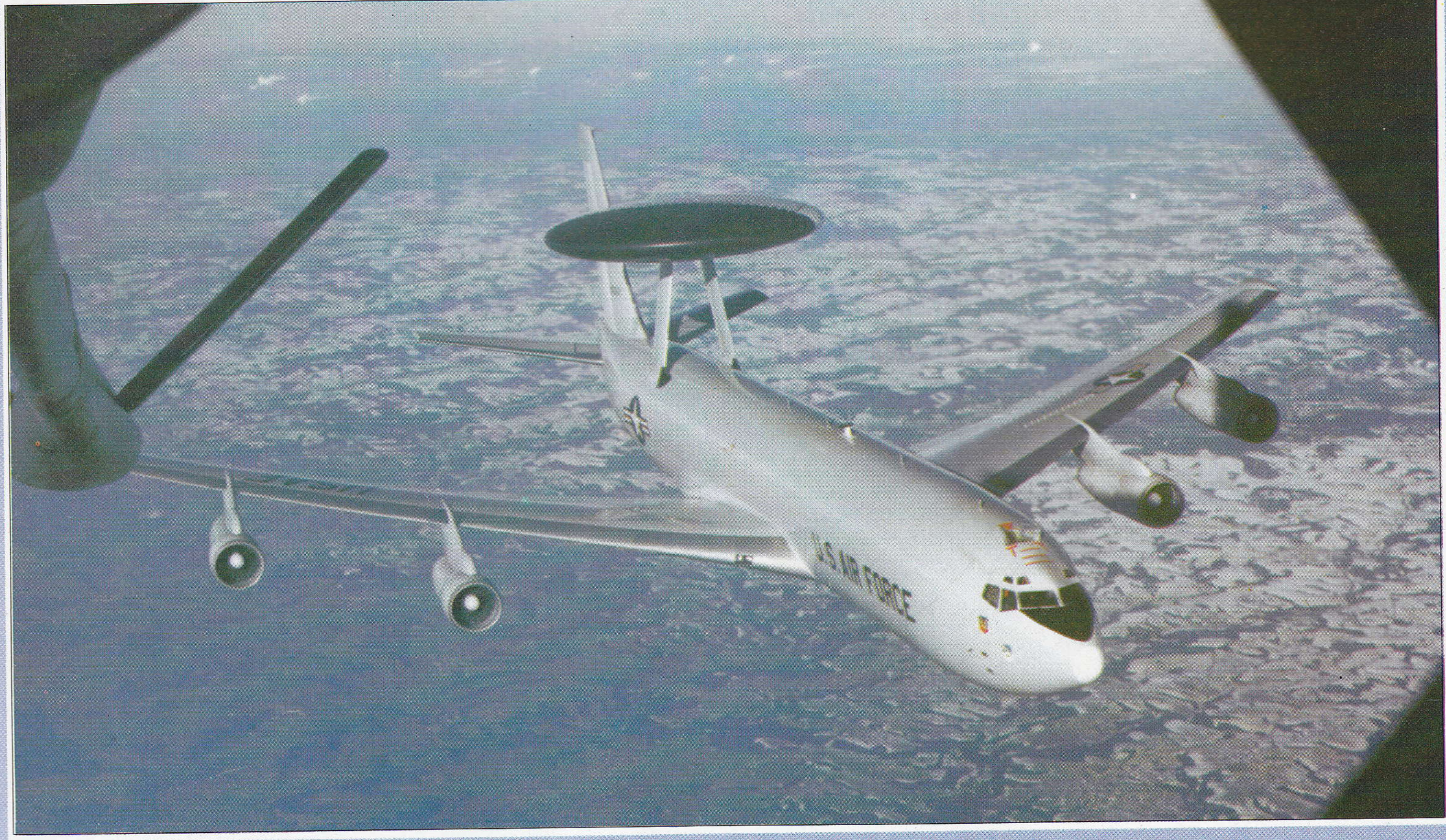
Since the Sentry entered service in 1977, this flexibility has been amply demonstrated by aircraft deploying to observe aerial activity in a number of 'hot-spots' on several occasions, an exercise which appears to be the modern equivalent of the ancient British practice of showing the flag by 'sending a gun-boat'. In addition to contingency operations, the Sentry is now active at a number of overseas locations on a permanent basis, such sites including Keflavik, Iceland, and Kadena (Okinawa), while ground-based radars of the NORAD (North American Air Defense Command) network are routinely augmented by E-3As operating from bases in the continental USA and Alaska.

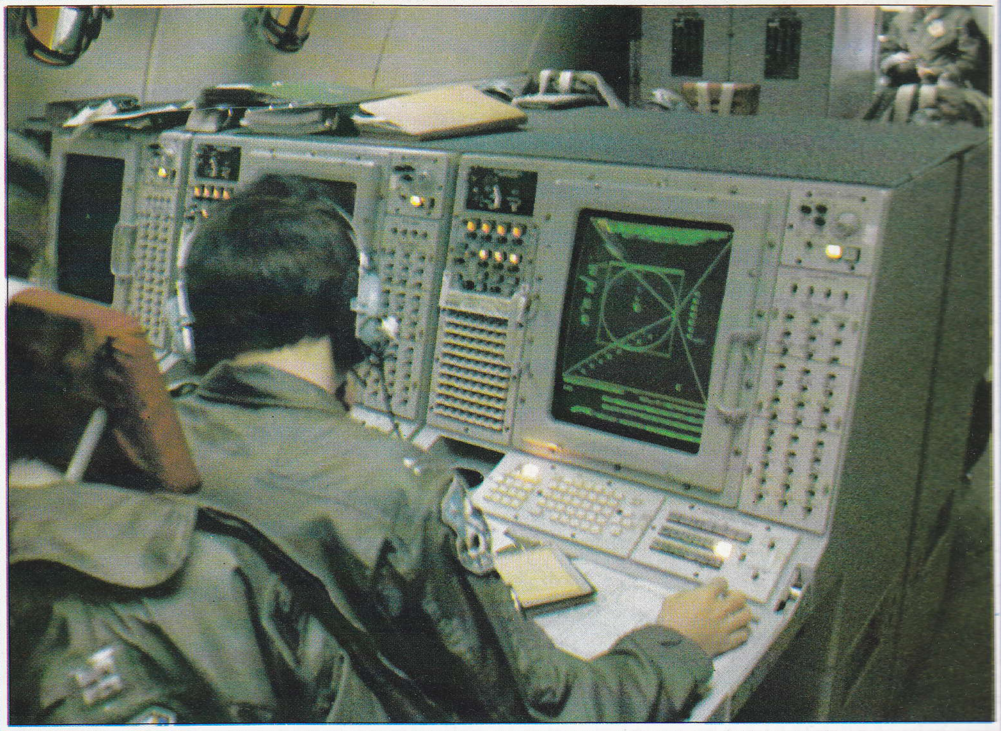
Although destined to soldier on until the late 1970s, the EC-121's shortcomings were a cause for considerable concern in the previous decade, but it was not until July 1970 that positive action to remedy this situation was taken with the award of a contract to Boeing covering the development, installation and flight testing of two separate and distinct airborne radars built by the Westinghouse Electric Corporation and the Hughes Aircraft Company respectively. To undertake this test project, Boeing constructed a brace of prototypes which were based on the well-proven Boeing 707-320B commercial transport and initially used the designation EC-137D. Subsequently, the designation was changed to E-3A which more accurately describes the Sentry's airborne early warning task.

Both of the prototypes flew for the first time early in 1972, and on conclusion of five months of competitive evaluation the Westinghouse system was adjudged to be superior, an announcement to this effect being made on 5 October 1972. In the event, further trials were deemed necessary to ensure that the radar was mission-capable, so it was not until late January 1973 that authorization for full-scale development (FSD) was given, a pair of production prototypes being ordered at about the same time to assist with the extensive trials effort. Even then, under the 'fly before buy' philosophy, decision to proceed with quantity production was not forthcoming until full-system operation was satisfactorily demonstrated, a hurdle negotiated successfully in April 1975.

FSD testing was, in essence, conducted in two principal areas, these comprising SID (Systems Integration Demonstration) and IOT&E (Initial Operational Test and Evaluation), all four flyable aircraft being involved, and this was followed by a most rigorous 16-month assessment managed by US Air Force Test and Evaluation Centre (AFTEC) personnel from Kirtland AFB, New Mexico. Beginning in August 1975, this involved a total of 451 flights and more than 1,800 flying hours which culminated in the most demanding examination yet when the E-3A took part in three major exercises in late 1976. In each case, the Sentry performed satisfactorily, proving conclusively that it could fulfil the desired function even in an intense ECM environment. This was virtually the last obstacle to be cleared, and the type thus began to join the US Air Force on 24 March 1977, when the first full production specimen was handed over to the 552nd Airborne Warning and Control Wing at Tinker AFB, Oklahoma. Training of personnel began immediately, but such is the complexity of the system that it was not until April of the following year that IOC (Initial Operating Capability) was achieved. Today, roughly 30 aircraft are in USAF service, all being attached to the 552nd AW&CW, and they routinely operate from bases at Tinker,

An inflight-refuelling boomer's view of a Core E-3A, gently coming closer with the ARR (air-refuelling receptacle) doors open above the cockpit. The TF33-100/100A engines have special high-capacity generators. The original plan was to use eight TF34 engines, which would have given longer endurance.





At one end of the SDCs an operator can utilize the impressive array of electronic equipment carried aloft by the Sentry. Each console allows detection functions as well as control and communications to be operated from the same panels.

Keflavik, Kadena, Riyadh and Elmendorf. Current planning anticipates procurement to an eventual total of 46 aircraft to permit additional back-up to NORAD.

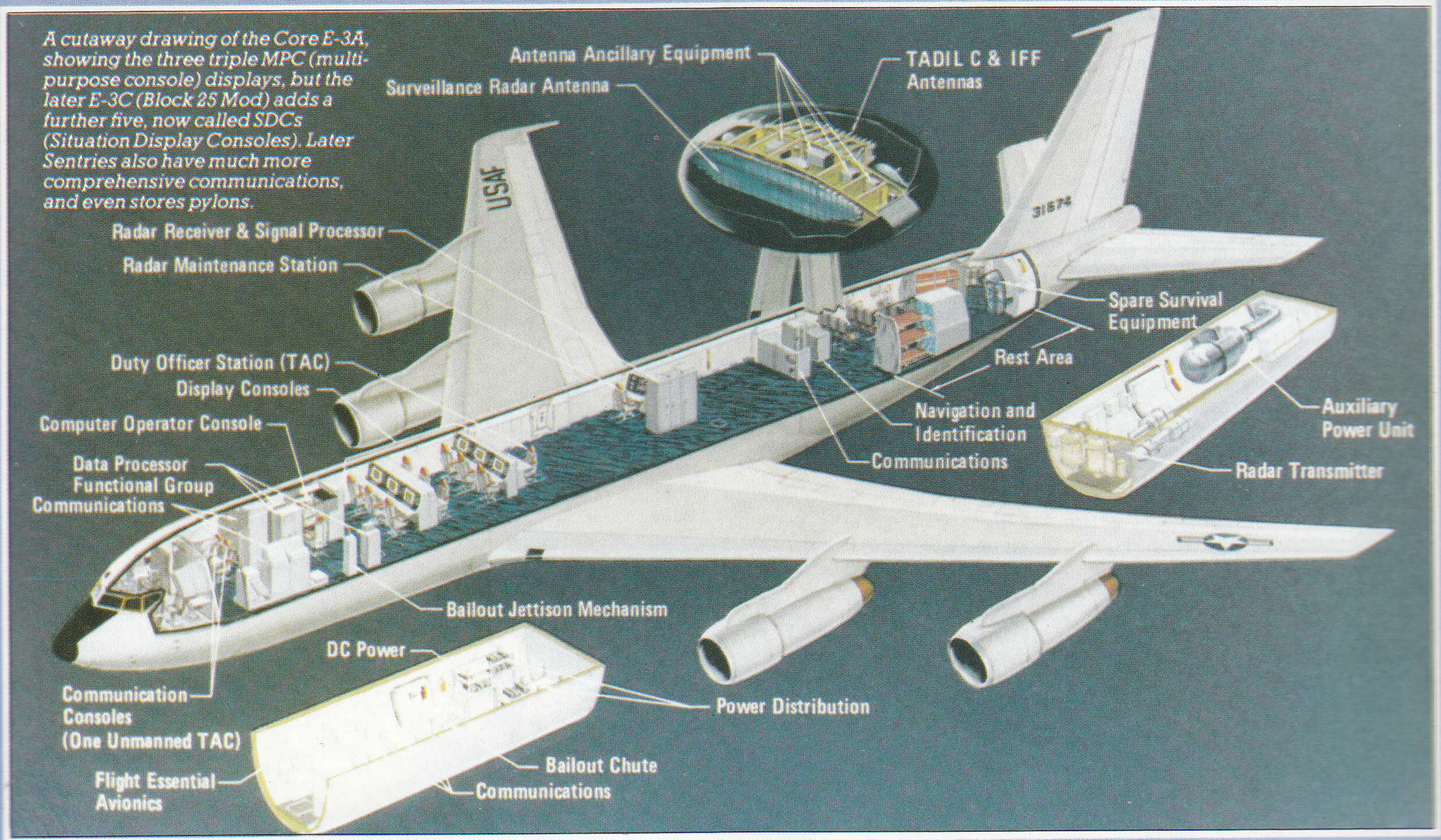
In broad terms, the E-3A is intended to perform two basic missions, namely tactical offence and strategic defence. In the former, it offers quick-reaction surveillance and C^3 (Command, Control and Communications) facilities necessary to the successful management of often-unwieldy tactical assets engaged in a variety of operations which include interdiction, close air support, rescue, reconnaissance and even airlift. Enemy aircraft operating at varying altitudes can be detected and tracked over all kinds of terrain, and the E-3A is also able to identify and control friendly air and ground forces active in the same area, alerting air- and ground-based command echelons to any threats that are detected and thus enabling them to take positive and timely action.

North American defence

As far as defensive applications are concerned, the E-3 represents a most effective way of deploying surveillance and C^3 facilities to detect, track, identify and intercept hostile aircraft. Accordingly, the Sentry is now a most important part of the NORAD network, being used periodically in conjunction with ground-based radars and control centres to manage defensive fighter assets. Indeed, the look-down capability of the E-3A is particularly effective in countering the threat posed by bombers operating at low level since these can often penetrate below the ground-based radar network's line of sight. Accordingly, the Sentry now features prominently in the routine training of air defence assets within the continental USA and Canada.

To fulfil these diverse tasks, the E-3A normally carries a crew of 17. Four are concerned wholly with flying the aircraft, the remainder being responsible for operating the impressive array of equipment carried; the number in the mission crew can vary slightly according to mision requirements. Cabin layout, moving from nose to tail, consists of the flight deck; communications, data-processing and other equipment bays; multi-purpose display consoles; communications; navigation and IFF (Identification Friend or Foe) equipment and, finally, crew rest area including bunks and a fairly comprehensive galley, always a welcome feature on long missions or deployments.

As already noted, the E-3 is essentially a modified Boeing 707-320B fitted with more powerful Pratt & Whitney TF33 turbofans, each rated at 9526-kg (21,000-lb) thrust. Externally, the aircraft differs little from its civilian counterparts with the obvious exception of the dorsal rotodome. Containing antennae for the Westinghouse radar as well as IFF and TADIL-C



A cutaway drawing of the Core E-3A, showing the three triple MPC (multi-purpose console) displays, but the later E-3C (Block 25 Mod) adds a further five, now called SDCs (Situation Display Consoles). Later Sentries also have much more comprehensive communications, and even stores pylons.

Antenna Ancillary Equipment
TADIL C & IFF Antennas
Surveillance Radar Antenna
USAF
31674
Radar Receiver & Signal Processor
Radar Maintenance Station
Spare Survival Equipment
Rest Area
Duty Officer Station (TAC)
Display Consoles
Auxiliary Power Unit
Navigation and Identification
Computer Operator Console
Communications
Radar Transmitter
Data Processor Functional Group
Communications
Ballout Jettison Mechanism
DC Power
Communication Consoles (One Unmanned TAC)
Power Distribution
Bailout Chute
Flight Essential Avionics
Communications

data-link equipment, the rotodome measures some 9.14 m (30 ft) in diameter, is 1.83 m (6 ft) deep and normally rotates at six revolutions per minute although it can also operate at just one revolution every four minutes, the latter rate being used during inflight-refuelling or on non-operational flights to keep the bearings from freezing and so seizing.

A most powerful system, the Westinghouse APY-1 radar has a detection range of the order of 400 km (250 miles) for aircraft operating at low level, this figure being somewhat greater for aircraft flying at medium to high altitudes. Using pulse-Doppler technology with a high pulse repetition rate to ensure great range and high accuracy in addition to 'look-down' capability, data generated by the radar and other systems are processed by an IBM 4Pi Cc-1 high-speed computer which can accomplish no less than 740,000 operations per second. Installed on the first 23 aircraft, the IBM computer comprises arithmetic control units, peripheral control units, input/output units, tape reader, mass memory drums, tape transports, line printer, main storage units and a control panel and has a maximum input/output data rate of 710,000 words per second with a main memory size of 131,072 words. Mass memory size is 802,816 words although there is considerable potential for expansion, whilst from the 24th example onwards an improved IBM computer is fitted, this featuring increased main storage capacity.

Command and control

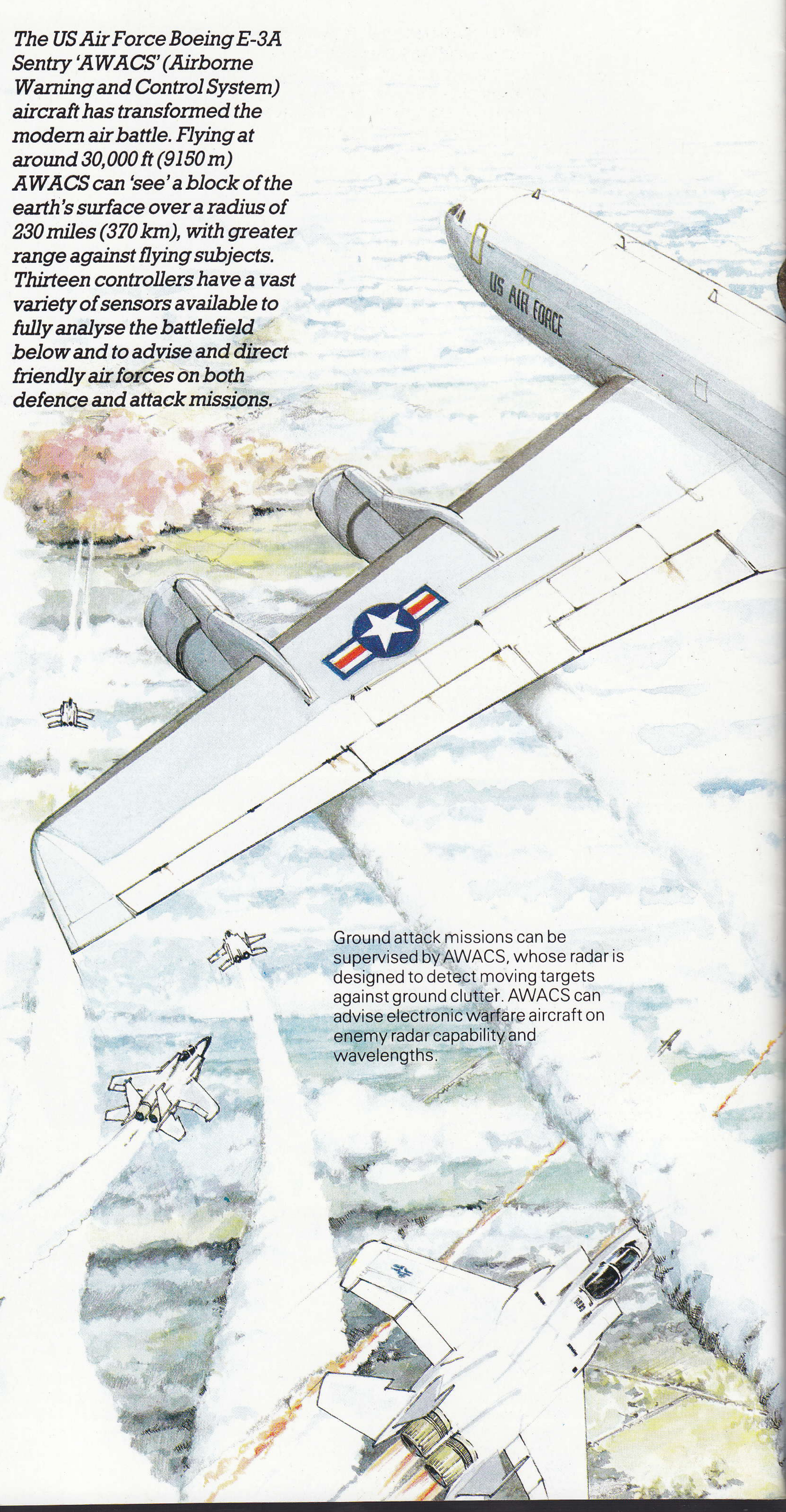
In addition, the E-3 has a total of nine multi-purpose consoles and two auxiliary display units, and it is from these that the task of control is accomplished, assistance being provided by a most impressive collection of communications equipment, including HF, VHF and UHF radio, it being possible to transmit or receive information in clear or secure modes in either voice or digital format. Incorporation of the Joint Tactical Information Distribution System (JTIDS) on later Sentries has raised the degree of communications security still further.

Another unique feature of the Sentry is the Cutler-Hammer AN/APX-103 interrogator set which is the first unit of its type to include AIMS Mk X SIF air traffic control and Mk XII military IFF in a single integrated system which instantly makes available data on range, azimuth, elevation, code identification and IFF status of all potential targets within radar range.

All of the mission-related avionics equipment is monitored by a built-in test facility which continually checks for malfunctions, automatically notifying any system defects to the crew so that corrective measures can be implemented, it being possible to undertake inflight maintenance; indeed, a sizable quantity of spare parts is routinely carried.

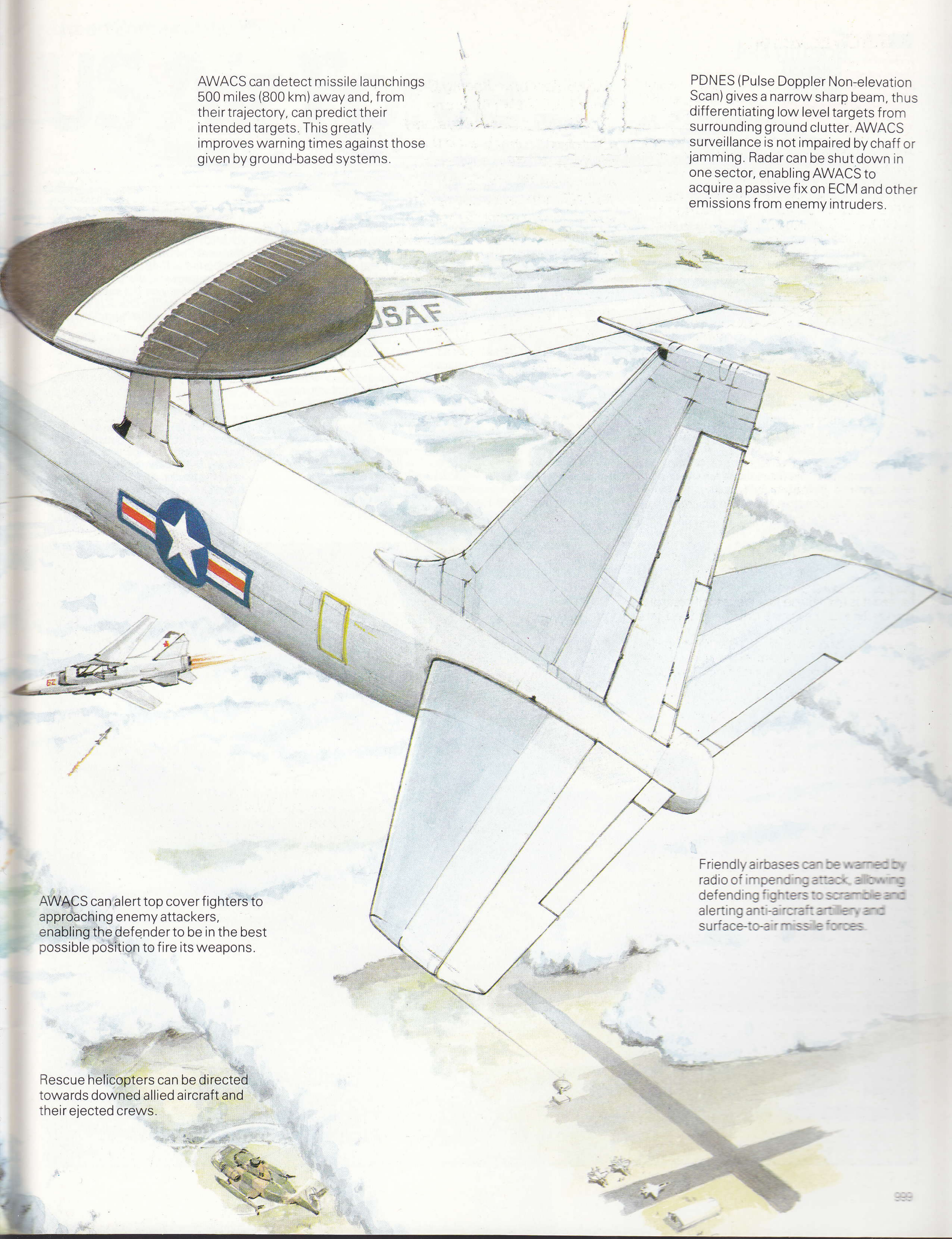
As far as future developments are concerned, considerable scope exists for improvement and consideration is being given to incorporating a number of refinements. For a start, target-tracking capability could be enhanced, whilst it will probably also prove desirable to provide a measure of self-defence potential in the form of radar warning receivers, chaff dispensers, ECM equipment and infra-red flares as a way of limiting vulnerability.

Even without such additions, the Sentry is already a most impressive piece of kit, the advent of this distinctive machine bringing about long-awaited and long-overdue improvement in US Air Force airborne early warning capability.



The US Air Force Boeing E-3A Sentry 'AWACS' (Airborne Warning and Control System) aircraft has transformed the modern air battle. Flying at around 30,000 ft (9150 m) AWACS can 'see' a block of the earth's surface over a radius of 230 miles (370 km), with greater range against flying subjects. Thirteen controllers have a vast variety of sensors available to fully analyse the battlefield below and to advise and direct friendly air forces on both defence and attack missions.

Ground attack missions can be supervised by AWACS, whose radar is designed to detect moving targets against ground clutter. AWACS can advise electronic warfare aircraft on enemy radar capability and wavelengths.



AWACS can detect missile launchings 500 miles (800 km) away and, from their trajectory, can predict their intended targets. This greatly improves warning times against those given by ground-based systems.

PDNES (Pulse Doppler Non-elevation Scan) gives a narrow sharp beam, thus differentiating low level targets from surrounding ground clutter. AWACS surveillance is not impaired by chaff or jamming. Radar can be shut down in one sector, enabling AWACS to acquire a passive fix on ECM and other emissions from enemy intruders.

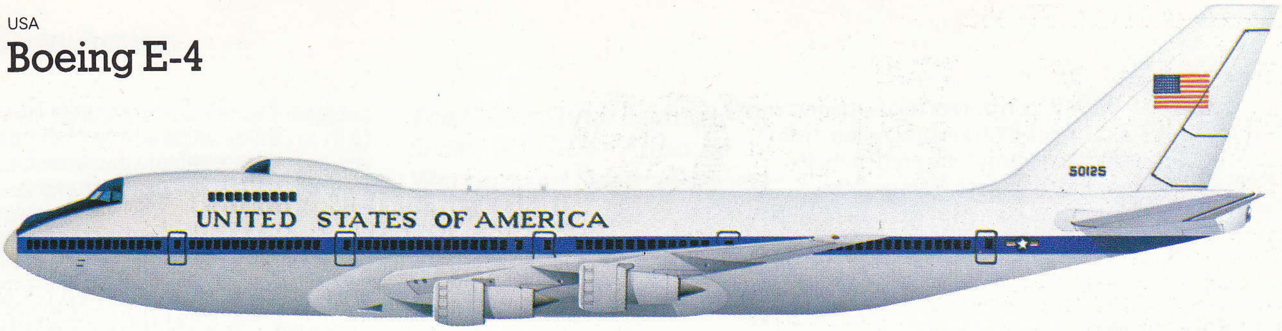
Friendly airbases can be warned by radio of impending attack, allowing defending fighters to scramble and alerting anti-aircraft artillery and surface-to-air missile forces.

AWACS can alert top cover fighters to approaching enemy attackers, enabling the defender to be in the best possible position to fire its weapons.

Rescue helicopters can be directed towards downed allied aircraft and their ejected crews.

USA

Boeing E-4



USAF no. 75-125 was the first AABNCP (Advanced Airborne National Command Post) to be completed to E-4B standard, with F103 engines and the 'doghouse' dorsal blister over the super-high-frequency satellite link. It is shown here with the original engines still installed (JT9Ds).

With the exception of the truly massive Lockheed C-5A Galaxy, the largest aircraft in the USAF inventory, the **Boeing E-4** is essentially a Boeing 747-200B optimized for use as an advanced airborne command post and, accordingly, it carries an impressive array of communications equipment, being fully capable of undertaking Strategic Air Command's 'Looking Glass' command post duty, Post-Attack Command and Control (PACC), or of serving as the National Emergency Airborne Command Post (NEACP) in which it would be manned by National Command Authorities including the President of the United States.

Two variants have appeared to date, the first being the **E-4A** which housed an electronic suite taken from an EC-135. Three aircraft were produced to this standard, the first making its maiden flight in June 1973, and all three are to be updated to **E-4B** configuration. A considerably more sophisticated array of communications and control equipment is installed in the E-4B, which first flew in August 1975, this equipment being produced by a consortium headed by E-Systems.

Incorporating SHF, LF/VLF and no less than 11 other communications systems, the E-4B can be refuelled in flight, thus extending mission duration, whilst the type also features accommodation for a much larger battle staff as well as 'hardening' against the effects of the electro-magnetic pulse attendant on nuclear explosions. Externally, the later model can be easily identified by the prominent dorsal fairing for the SHF antenna.

Thus far only one new-build E-4B has been produced by Boeing, but the USAF is planning to acquire a further two which will result in a fleet of six when all three E-4As have been updated to the later standard. Operationally, all of the four machines now in service are assigned to SAC's 1st Airborne Command and Control Squadron at Offutt AFB, Nebraska, but one example is always kept at Andrews AFB (near Washington, DC) on NEACP stand-by duty

Specification

Boeing E-4B

Type: airborne command post

Powerplant: four 23814-kg (52,500-lb) thrust General Electric F103-GE-100 turbofans

Performance: maximum speed 978 km/h (608 mph) at altitude; range 10460 km (6,500 miles) on internal fuel; endurance 12 hours on normal missions, or up to 72 hours on refuelled missions

Weights: empty about 172368 kg (380,000 lb); maximum take-off 352901 kg (778,000 lb)

Dimensions: span 59.64 m (195 ft 8 in); length 70.51 m (231 ft 4 in); height 19.33 m (63 ft 5 in); wing area 511.0 m^2 (5,500 sq ft)

At present the heaviest, most powerful and most expensive military aircraft in the world, the Boeing E-4Bs carry a crew of up to 94 on three decks. A battle staff of 30 handles the flow of information through the aircraft, which may be half a world away from its home at Offutt AFB.

50125
UNITED STATES OF AMERICA

US Air Force
Part 6

The 41st Rescue and Weather Reconnaissance Wing at McClellan AFB, California, is the second major ARRS sub-unit, controlling the 33rd ARRS at Kadena (HH-3E, HH-53C and HC-130) and the 41st ARRS at McClellan (HH-53C and HC-130) plus three weather reconnaissance squadrons engaged in the provision of meteorological data and forecasts as well as the more hazardous task of hurricane tracking. Two squadrons (the 53rd WRS and the 54th WRS at Keesler AFB, Mississippi, and at Andersen AFB, Guam, respectively) are equipped with WC-130s whilst the third (the 55th WRS at McClellan) has WC-135Bs.

In addition to these, the 23rd Air Force also exercises control over a fairly widespread collection of special operations units inherited from TAC, USAFE and PACAF, grouped together under the auspices of the 2nd Air Division. Briefly, these consist of the 1st Special Operations Wing at Hurlburt Field, Florida, with three squadrons operating MC-130ES, AC-130Hs and CH-3Es respectively; the 1st SOS at Clark in the Philippines with the MC-130E; and the 7th SOS at Rhein-Main AB, West Germany, also with MC-130Es.

The only other front-line combat organization situated on US territory is Alaskan Air Command (AAC) which has as its main purpose the detection of an impending air attack on the USA and Canada. Consequently, it is responsible for managing many radars, communications centres and other facilities of which perhaps the most widely known is the DEW (Distant Early Warning) Line. Continuing exploration for and development of the plentiful natural resources in Alaska have helped to make this somewhat bleak and desolate state of increasing importance to the entire North American continent, and it is hardly surprising in view of this that the small number of aircraft-operating combat units have recently been dramatically updated with an infusion of McDonnell Douglas F-15 Eagles and Fairchild Republic A-10A Thunderbolts.

Located at Elmendorf AFB, AAC headquarters co-

UNITED STATES OF AMERICA

Immaculately finished with blue and gold trim, this McDonnell Douglas VC-9C Nightingale VIP transport, from Andrews AFB, Maryland, was one of three procured in 1975. These aircraft are essentially DC-9 Series 30s with special VIP interiors and are used by the 1st MAS, 89th MAG, 76th MAW. This aircraft, 11-681, was the first of the three VC-9Cs to be delivered.

An M-551 Sheridan tank is loaded aboard a Lockheed C-130 Hercules. The Hercules entered service in December 1956 and enormous numbers remain in service in a variety of roles.

MAC
10875
U.S. AIR FORCE

A McDonnell Douglas C-9A Nightingale aeromedical evacuation transport. The Nightingale was delivered to Military Airlift Command in 1968; a handful of the 24 procured serve as transports, and these lack the medevac 'red cross' on the fin.

ordinate the activities of a small number of tactical units, foremost of which is probably the 21st TFW which shares the same base, having one squadron of F-15 Eagles for interception and air superiority and one squadron of vintage Lockheed T-33As for communications, ECM chaff duties and target-towing. The F-15 squadron keeps a small number of aircraft on alert at Elmendorf and also maintains separate detachments for air defence duties at Eielson AFB, King Salmon airport and Galena Air Force Station.

AAC's second major tactical echelon is the 343rd Composite Wing at Eielson, this controlling one fighter squadron with the A-10A for close air support plus a Tactical Air Support Squadron with a mixture of Cessna O-2As and Lockheed T-33As for forward air control tasks. In addition to these AAC-dedicated forces, both SAC and MAC have a permanent presence in Alaska, operating from Eielson and Elmendorf respectively, and details of these can be found in their respective sections.

MILITARY AIRLIFT COMMAND

HEADQUARTERS SCOTT AFB, II
- **21ST AF, McGUIRE AFB, NJ**
- **22ND AF, TRAVIS AFB, Ca**
- **23RD AF, SCOTT AFB, II**
- **AIR WEATHER SERVICE, SCOTT AFB, II**
- **375TH AEROMEDICAL AIRLIFT WING, SCOTT AFB, II**
- **AEROSPACE AUDIOVISUAL SERVICE, NORTON AFB, Ca**
- **USAF AIRLIFT CENTER, POPE AFB, NC**

375TH AEROMEDICAL AIRLIFT WING, SCOTT AFB, II
- 11th AAS, Scott AFB, II (C-9A)
- 1400th MAS, Norton AFB, Ca (CT-39A)
  - Det 1, McClellan AFB, Ca (CT-39A)
  - Det 2, Randolph AFB, Tx (CT-39A)
  - Det 3, Bergstrom AFB, Tx (CT-39A)
  - Det 4, Kirtland AFB, NM (CT-39A)
- 1401st MAS, Scott AFB, II (CT-39A)
  - Det 1, Offutt AFB, Ne (CT-39A)
  - Det 2, Wright-Patterson AFB, Oh (CT-39A)
  - Det 3, Barksdale AFB, La (CT-39A)
  - Det 4, Peterson AFB, Co (CT-39A)
- 1402nd MAS, Andrews AFB, Md (CT-39A)
  - Det 1, Langley AFB, Va (CT-39A)
  - Det 2, Shaw AFB, SC (CT-39A)
  - Det 3, Maxwell AFB, Al (CT-39A)
  - Det 4, Eglin AFB, Fl (CT-39A)

21ST AIR FORCE, McGUIRE AFB, NJ

- 76th Airlift Division, Andrews AFB, Md
  - 89th MAW, Andrews AFB, Md
    - 1st HS (UH-1N, CH-3E)
    - 1st MAS (C-6A, C-9C, C-12A, C-137B/C, C-140B, C-135)
    - Det 1 (C-135C at Hickam AFB, HI)
- 317th TAW, Pope AFB, NC
  - 39/40/41 TAS (C-130E)
- 322nd AD, Ramstein AB, West Germany
  - 435th TAW, Rhein-Main AB, West Germany
    - 37th TAS (C-130E)
    - 55th AAS (C-9A)
    - 58th MAS (C-12A, CT-39A, C-135B, C-140B at Ramstein)
    - 7111th OS (C-9A)
    - 7405th OS (C-130E)
  - 313th TAG, RAF Mildenhall, UK (TDY C-130E/H)
- 436th MAW, Dover AFB, De
  - 9/20 MAS (C-5A)
- 437th MAW, Charleston AFB, SC
  - 3/41/76 MAS (C-141B)
- 438th MAW, McGuire AFB, NJ
  - 6/18/30 MAS (C-141B)

22ND AIR FORCE, TRAVIS AFB, Ca

- 60th MAW, Travis AFB, Ca
  - 22/75 MAS (C-5A)
  - 7/44 MAS (C-141B)
- 62nd MAW, McChord AFB, Wa
  - 4/8 MAS (C-141B)
  - 36 TAS (C-130E)
- 63rd MAW, Norton AFB, Ca
  - 14/15/53 MAS (C-141B)
- 314th TAW, Little Rock AFB, Ar
  - 16 TATS (C-130E/H)
  - 48/61/62 TAS (C-130E)
- 443rd MAW (Training), Altus AFB, Ok
  - 56 MATS (C-5A)
  - 57 MATS (C-141B)
- 463rd TAW, Dyess AFB, Tx
  - 772/773/774 TAS (C-130H)
- 616th MAG, Elmendorf AFB, Ak
  - 17 TAS (C-130E)
- 834th AD, Hickam AFB, HI
  - 374th TAW, Clark AB, Philippines
    - 20 AAS (C-9A)
    - 21 TAS (C-130E/H)
  - 316th TAG, Yokota AB, Japan
    - 345 TAS (C-130E)

23RD AIR FORCE, SCOTT AFB, II

- 2nd Air Division, Hurlburt Field, Fl
  - USAF Special Operations School, Hurlburt Field, Fl
  - 1st Special Operations Wing, Hurlburt Field, Fl
    - 8 SOS (MC-130E)
    - 16 SOS (AC-130H)
    - 20 SOS (HH-53, UH-1N)
  - 1st SOS, Clark AB, Philippines (MC-130E PACAF OpCon)
  - 7th SOS, Rhein-Main AB, West Germany (MC-130E USAFE OpCon)
  - Det 1, Howard AFB, Canal Zone (UH-1N)
- Aerospace Rescue and Recovery Service, Scott AFB, II
  - 39th Aerospace Rescue and Recovery Wing, Eglin AFB, Fl
    - Det 5, Tyndall AFB, Fl (HH-3E)
    - Det 10, MacDill AFB, Fl (HH-1H)
    - Det 11, Myrtle Beach AFB, SC (CH/HH-3E)
    - Det 15, Patrick AFB, Fl (CH-3E)
    - 37 ARRS, F.E. Warren AFB, Wy
      - Det 1, Davis-Monthan AFB, Az (UH-1N)
      - Det 2, Ellsworth AFB, SD (UH-1F)
      - Det 3, Grand Forks AFB, ND (UH-1F)
      - Det 4, Little Rock AFB, Ar (HH-1H)
      - Det 5, Malmstrom AFB, Mt (UH-1F)
      - Det 6, McConnell AFB, Ks (HH-1H)
      - Det 7, Minot AFB, ND (UH-1F)
      - Det 8, Vandenberg AFB, Ca (UH-1F)
      - Det 9, Whiteman AFB, Mo (UH-1F)
      - Det 10, F.E. Warren AFB, Wy (TH/UH-1F)
    - 40th ARRS, Hill AFB, Ut
      - Det 1, Homestead AFB, F1 (HH-1H)
      - Det 4, Hill AFB, Ut (HH-1N)
      - Det 5, Edwards AFB, Ca (HH-1N)
      - Det 6, Holloman AFB, NM (HH-1N)
      - Det 18, Plattsburgh AFB, NY (HH-1N)
      - Det 22, Mountain-Home AFB, Id (HH-1N)
      - Det 24, Fairchild AFB, Wa (UH-1N)
    - 55 ARRS, Eglin AFB, Fl (HC-130N/P, HH-53H, UH-60A)
    - 67 ARRS, RAF Woodbridge, UK (HC-130H/N/P, HH-53C)
      - Det 2, Ramstein AB, West Germany (UH-1N)
      - Det 9, Stuttgart Apt, West Germany (HH-1H)
      - Det 14, Keflavik, Iceland (HH-3E).
  - 41st Rescue and Weather Reconnaissance Wing, McClellan AFB, Ca
    - 33 ARRS, Kadena AB, Okinawa (HC-130H/N/P, HH-53C)
      - Det 1, Clark AB, Philippines (CH/HH-3E)
      - Det 13, Osan AB, South Korea (CH/HH-3E)
    - 41 ARRS, McClellan AFB, Ca (HC-130H/N/P, HH-53C)
    - 53 WRS, Keesler AFB, Mo (WC-130E/H)
    - 54 WRS, Andersen AFB, Guam (WC-130E/H)
    - 55 WRS, McClellan AFB, Ca (WC-135B)
    - 71 ARRS, Elmendorf AFB, Ak (HC-130H/N, HH-3E)
- 1550th Aircrew Test and Training Wing, Kirtland AFB, NM
  - 1550 FTS (TH-1F, UH-1N)
  - 1551 FTS (HC-130H/P, HH-3E, HH-53C/H)